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Introduction

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By arrangement between NASA and the American Institute of Aeronautics and Astronautics, the AIAA publication *International Aerospace Abstracts* is issued in coordination with *STAR*. Each journal appears on alternate weeks. *IAA* uses subject categories identical with those in *STAR*, and publishes similar indexes. *IAA's* worldwide coverage of books and scientific and trade journals complements *STAR's* worldwide report coverage. The two publications thus provide comprehensive access to current literature on aerospace science and technology.

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INDEXING VOCABULARY

The Preliminary Edition of the *NASA Thesaurus* (December 1967) (NASA SP-7030) is being used as the authority for the indexing vocabulary that appears in the subject index to this issue. The terminology has been modified from the *Guide to the Subject Indexes for STAR* (NASA SP-7016), the authority used for the vocabulary to indexes published prior to 1968. The *NASA Thesaurus* should be consulted for a total picture of the current indexing vocabulary including associated cross reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus* may be obtained from the Clearinghouse for Federal Scientific and Technical Information or the U. S. Government Printing Office at a price of $8.50 for the three-volume set.

Volume 6 Number 14 / July 23, 1968

TABLE OF CONTENTS

Subject Categories

Abstracts in the journal are grouped under the following categories: *page:*

01 AERODYNAMICS
Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion. **2179**

02 AIRCRAFT
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **2183**

03 AUXILIARY SYSTEMS
Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems. **2190**

04 BIOSCIENCES
Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology. **2195**

05 BIOTECHNOLOGY
Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences. **2203**

06 CHEMISTRY
Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants. **2208**

07 COMMUNICATIONS
Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. **2220**

08 COMPUTERS
Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics. **2226**

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. **2229**

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories. **2231**

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations. **2234**

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. **2239**

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. **2243**

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras. **2253**

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; reliability; drafting; and materials fabrication, handling, and inspection. **2262**

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State. **2266**

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see : 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics. **2267**

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics. **2275**

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers. **2279**

20 METEOROLOGY
Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences. **2282**

21 NAVIGATION
Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications. **2286**

22 NUCLEAR ENGINEERING
Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems. **2287**

23 PHYSICS, GENERAL
Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics, 20 Meteorology, and 29 Space Radiation. **2296**

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR
Includes atomic, molecular and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation. **2301**

25 PHYSICS, PLASMA
Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems. **2321**

26 PHYSICS, SOLID-STATE
Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics. **2328**

27 PROPELLANTS
Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems. **2336**

28 PROPULSION SYSTEMS
Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants. **2236**

29 SPACE RADIATION
Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear. **2338**

30 SPACE SCIENCES
Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbits and trajectories. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles. **2341**

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics. **2349**

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic. **2353**

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants. **2369**

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents. **2376**

SUBJECT INDEX I-1

PERSONAL AUTHOR INDEX I-69

CORPORATE SOURCE INDEX I-99

REPORT/ACCESSION NUMBER INDEX I-117

ACCESSION/REPORT NUMBER INDEX I-127

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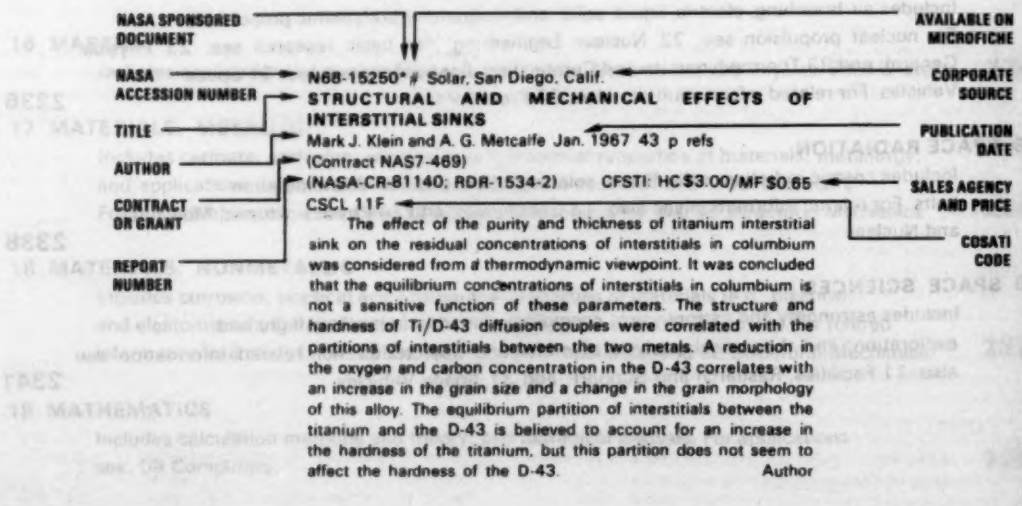
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The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43.
Author

VOLUME 6, NUMBER 14 / JULY 23, 1968

Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N68-24345# Sandia Corp., Albuquerque, N. Mex. Reentry and Space Sciences Div.

ONE-DEGREE-OF-FREEDOM AUTOROTATION CHARACTERISTICS OF FLAT PLATES AT LOW SUBSONIC SPEEDS

George W. Stone Jul. 1967 10 p Presented at the 6th AIAA Aerospace Sci. Meeting, New York

(Contract AT(29-1)-789)

(SC-DC-67-1951; CONF-680101-1) CFSTI: HC $3.00/MF $0.65

In order to understand and analyze the free flight dynamics of flat plates, a subsonic, one-degree-of-freedom wind tunnel test was conducted to determine the dynamic stability characteristics of typical flat plate models. The wind tunnel models consisted of three rectangular flat plates and one circular disc pinned to supports so that each model was free to tumble on precision ball bearings about an axis through its center of gravity. The wind tunnel conditions included sea level density, air speeds from 23 to 45 mph, and a 90° angle of attack. The tests showed that these configurations would autorotate when constrained about one axis; that the rate of autorotation increased linearly with velocity over the range of air speed used; and that the dynamic stability characteristics of flat plates are highly nonlinear with the square of the reduced frequency. A new technique was developed for calculating dynamic stability derivatives from the total angular energy of the system. NSA

N68-24414# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

COMPUTATION OF EQUILIBRIUM HYPERSONIC FLOW ABOUT BLUNT AXISYMMETRIC BODIES WITH SHARP CORNERS Final Report

J. T. Curtis and C. R. Strom Aug. 1967 134 p refs Prepared for Sandia Corp.

(SC-CE-67-2749) CFSTI: HC $3.00/MF $0.65

Certain modifications and extensions to the unified, nonequilibrium chemistry, blunt-body flow field program, which has been developed at Cornell Aeronautical Laboratory during the past several years, are presented. These modifications consist of the inclusion of an equilibrium chemistry option and routines for handling embedded shocks and expansion fans originating from sharp corners on the afterbody of a two-dimensional or axisymmetric shape. The gas dynamic analysis required to treat these special problems as well as the details of the coding for the computer are described. Author (NSA)

N68-24474*# Aztec School of Languages, Inc., Acton, Mass.

INVESTIGATION OF THE STABILITY OF A TWO-BLADED ROTOR ON AN ANISOTROPIC BASE [ISSLEDOVANIYE USTOYCHIVOSTI DVUKHLOPASTNOGO NESUSHCHEGO VINTA NA ANIZOTROPNOM UPRUGOM OSNOVANII]

R. S. Musalimova Washington NASA May 1968 7 p refs Transl. into ENGLISH from Mashinostr. (Kiev), no. 4, 1967 p 31-35

(Contract NASw-1692)

(NASA-TT-F-11660) CFSTI: $3.00 CSCL 01A

The results of the effect of the most important parameters (coefficient of anisotropy of the base, and frequency of natural oscillations of the blade caused by the flexibility in the vertical link) on the stability are examined. The data obtained show the error in a previous study which stated that, if the rigidities of the base in different directions do not differ too greatly from one another, the support can be considered as isotropic. Author

N68-24518# General Electric Co., Philadelphia, Pa.

THE EFFECTS OF AERODYNAMIC DISTURBANCES ON SPIN-STABILIZED SPACE VEHICLES

J. O. Williams (M.S. Thesis—Pennsylvania Univ.) Dec. 1967 27 p refs

(Rept.-67SD349)

Throughout the literature on spin stabilized space vehicles, most of the approaches presented were concerned with the effect of constant aerodynamic disturbances on the orientation of the vehicle. These analyses were usually associated with space vehicles which are in high altitude, circular orbits. Although the extension of the approaches utilized in these studies to include non-circular orbits and non-constant aerodynamic disturbances seems obvious, there is not an abundance of literature available which has actually performed the generalized analysis. This thesis determines the effect that aerodynamic disturbances have on the orientation of a space vehicle which is spinning about one of its body-fixed axes. Since the space vehicle is considered to be in a non-circular orbit, these disturbances are, consequently, time varying. Employing the Euler equation for rotational motion and Euler angle relationships, a generalized expression is obtained for the variation of the spin axis of the space vehicle from a fixed direction. Author

N68-24617# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

APPROXIMATION OF THE SPANWISE DISTRIBUTION OF WIND-TUNNEL-BOUNDARY INTERFERENCE ON LIFT OF WINGS IN RECTANGULAR PERFORATED-WALL TEST SECTIONS

Ray H. Wright and Benferd L. Schilling Washington May 1968 39 p refs

(NASA-TR-R-285) CFSTI: HC $3.00/MF $0.65

An approximation method was developed for calculating the spanwise distribution of wind-tunnel-boundary upwash interference on lift of wings in rectangular perforated-wall test sections. This method is applied to square test sections with an assumed effective permeability constant of 0.6. A problem of considerable difficulty in practical application of the method presented is the estimation of an effective permeability constant. Because of the variation of the upwash interference with Mach number and of the influence of boundary layer on the effective permeability factor, the boundary interference in a perforated-wall wind-tunnel test section at high subsonic Mach numbers is likely to be of the nature of that in an open-throat tunnel. Author

N68-24693# Ohio State Univ., Columbus.
AN INVESTIGATION OF AERODYNAMIC CONTROLS AT HYPERSONIC MACH NUMBERS
Anthony William Fiore (Ph.D. Thesis) 1966 162 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-2441

A research program was conducted to investigate the behavior of a flat plate wing with a semi-cylindrical leading edge at a Mach number of 13.87 and an approximate Reynolds number, based on the leading edge thickness, of 39.35. Pressure distributions for each control surface location, in the presence of combined separated and expansion type flow fields, were obtained. These pressure distributions were integrated and the resulting two-dimensional force and moment coefficients, lift-to-drag ratio, and location of the center of pressure were compared with inviscid theory. The effect of cross-flow through an open gap between the wing and the control surface was analyzed, and these data indicate the effect to be present for both leading and trailing edge control location. Aerodynamic control effectiveness and control surface hinge moments were investigated as a function of control surface location, and the results were compared with inviscid theory. Dissert. Abstr.

N68-24754# Scripta Technica, Inc., Washington, D. C.
NUMERICAL CALCULATION OF THE FLOW IN A REGION OF SPHERICAL BLUNTNESS AT SMALL REYNOLDS NUMBERS [CHISLENNY RASCHET TECHNENIYA V OBLASTI SFERICHESKOGO ZATUPLENIYA PRI MALYKH CHISLAKH REYNOL'DSA]
V. S. Gorislavskiy and A. I. Tolstykh Washington NASA May 1968 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidkosti I Gaza, no. 5, 1967 p 93-98
(Contract NASw-1694)
(NASA-TT-F-11402) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Application of a method used by Tolstykh and Belotserkovskii to calculate supersonic flows of a viscous gas past circular cylinders to the calculation of such flows past axisymmetric blunt bodies at small Reynolds numbers. The aerodynamic characteristics of the flows are obtained under the assumption that the equations of continuum mechanics retain their validity. The results obtained theoretically are compared with those obtained experimentally and with other approximate methods. Author

N68-24760# Aeronautical Research Council (Gt. Brit.).
ALGOL 60 PROGRAMME FOR MULTHOPP'S LOW-FREQUENCY SUBSONIC LIFTING-SURFACE THEORY
H. C. Garner and D. A. Fox London HMSO 1968 46 p refs Supersedes NPL-AERO-1192, ARC-27926, N67-17256
(ARC-R&M-3517; NPL-AERO-1192; ARC-27926) HMSO: £1

An improved programme for the KDF9 digital computer is described and illustrated. The mathematical equations, general flow diagrams and the Algol text are presented. The improvements incorporate a new procedure for evaluating the influence functions and a scheme for more accurate spanwise integration without increase in the number of collocation sections. Up to four chordwise terms are included, but the extension to five or more terms should be straight-forward in principle. Author

N68-24768# Aeronautical Research Council (Gt. Brit.).
THE VARIATION OF PROFILE DRAG WITH MACH NUMBER UP TO CRITICAL VALUE. A COMPARISON OF RECENT PREDICTIONS WITH EARLY FLIGHT AND WIND-TUNNEL MEASUREMENTS AND A COMMENT ON AN EARLIER PREDICTION
J. Osborne London HMSO: 9s 1968 21 p refs Supersedes NPL-AERO-1137, ARC-28207, N67-17331
(ARC-R&M-3520; NPL-AERO-1197; ARC-28107) HMSO: 9s

Flight measurements made by Mair in 1942, with the wake traverse method, used to extend to high Reynolds numbers (2×10^7) and a thick section (18%t/c) the verification that the sub-critical creep (slow increase with increasing Mach number) in profile-drag coefficient can now be predicted accurately. Good agreement is also obtained between the absolute magnitude (as distinct from creep) of the measured drag and of that predicted on the basis of boundary-layer transition having occurred near the leading edge. Similar agreement is obtained with a drag coefficient measured on a two-dimensional aerofoil ($R=1{\cdot}6\times10^6$) of an almost identical section with transition positions now known to have been at 39% chord. The analysis shows that predicted profile drag, particularly at high sub-critical Mach numbers, is sensitive to the actual compressible-flow pressure distribution used in its derivation, and that the errors due to inaccuracies of the older compressibility laws can be especially important for sections of this thickness, with the particular type of velocity distribution involved. This last point is shown to be the probable reason for the failure of the analysis of Young and Winterbottom (1940) to predict any significant sub-critical drag creep. Author

N68-24769# Aeronautical Research Council (Gt. Brit.).
THE EFFECT OF TURBULENCE ON STATIC PRESSURE TUBES
P. Bradshaw and D. G. Goodman London HMSO 1968 11 p refs Supersedes NPL-AERO-1210, ARC-28327, X67-17319
(ARC-R&M-3527; NPL-AERO-1210; ARC-28327) HMSO: 5s 6d

Measurements on the centreline of a circular jet confirm the suggestion of Barat and Toomre that the error in static-tube reading due to turbulent fluctuations depends on the ration of the size of the tube to the size of typical turbulent eddies. The reading of tubes of a size likely to used in practice is nearer to the actual static pressure than to either of the asymptotic theoretical predictions. Author

N68-24770# Aeronautical Research Council (Gt. Brit.).
GENERALISED AIRFORCES ON A CYLINDRICAL SHELL OSCILLATING HARMONICALLY IN A UNIFORM FLOW
D. E. Davies London HMSO 1968 53 p refs Supersedes RAE-TR-65295, ARC-28202, N67-22788
(ARC-R&M-3534; RAE-TR-65295; ARC-28202)

The flow of air past an infinite shell is considered. In its undisturbed state the shell is a circular cylinder. A portion of the shell between two normal cross-section if flexible, the rest of the shell being rigid and fixed. The flexible portion is closed by planes normal to the axis of the cylinder. In the absence of any oscillations of the flexible portion there is a uniform flow outside the cylinder, which has the direction of the axis of the cylinder. When the flexible portion oscillates, the uniform flow is perturbed and there is also an acoustic field generated in the space within the flexible portion with the result that there are oscillating perturbation pressures on both sides of the shell surface. A method of determining these perturbation pressures is given when the flexible portion oscillates harmonically with given frequency in a given mode. Expressions for these perturbation pressures are then used to obtain formulae for the associated generalised airforces. Author

N68-24791# Aeronautical Research Council (Gt. Brit.).
A GRAPHICAL REPRESENTATION OF THE BINARY FLUTTER EQUATIONS IN NORMAL CO-ORDINATES

L. T. Niblett London HMSO 1968 36 p refs Supersedes RAE-TR-66001, ARC-27991, X66-20605
(ARC-R&M-3496; RAE-TR-66001; ARC-27991) HMSO: 15s 6d

A graphical representation of the solution of the flutter equations for a binary system is developed in which the effect of aerodynamic damping is separated into two parts. This division is thought to make the significance of the relative sizes of the damping coefficients more comprehensible. The method is applied to some typical binary systems and some general properties of binary systems are derived. It is shown that nearly-equal direct-damping coefficients and small damping couplings lead to near-maximum flutter speeds and that, in general, the lower the air density the lower is the equivalent airspeed for flutter. The simplifications made in the 'frequency-coalescence' theory of flutter are clarified. Author

N68-24792# Aeronautical Research Council (Gt. Brit.).
MEASUREMENT OF SKIN FRICTION AT LOW SUBSONIC SPEEDS BY THE RAZOR-BLADE TECHNIQUE
L. F. East London HMSO 1968 26 p refs Supersedes RAE-TR-66277, ARC-28724
(ARC-R&M-3525; RAE-TR-66277; ARC-28724) HMSO: 11s 6d

The technique consists of forming a surface pitot-tube by placing a small segment of razor blade on the surface with its tapered cutting edge above a static-pressure hole. The effects of limited changes in the razor-blade geometry on the measured pressure have been determined in a two-dimensional turbulent boundary layer and a calibration curve for a particular standardised geometry deduced. The variation of pressure due to yawing the blade segments in three-dimensional boundary layers, similar to those likely to occur on aerodynamic models, is found to be independent of the nature of the boundary layer. From this a method of using razor-blade segments to measure skin friction in three-dimensional boundary layers is proposed, which does not necessitate prior knowledge of the surface-flow direction. Author

N68-24815# Aeronautical Research Council (Gt. Brit.).
THE SUBCRITICAL RESPONSE AND FLUTTER OF A SWEPT-WING MODEL
C. A. K. Irwin and P. R. Guyett London HMSO Aug. 1965 Aug. 1965 refs Supersedes RAE-TR-65186, ARC-27610, N67-28159
(ARC-R&M-3497; RAE-TR-65186; ARC-27610) HMSO: 15s

The dampings and frequencies of the lower natural modes of oscillation of an aeroelastic, swept-wing model at wind speeds below its critical flutter speed have been deduced from measurements of the displacement-vector response of the model under sustained excitation. The flutter speed and frequency were also measured. The tests were done in a wind tunnel at low subsonic speeds. Calculations were made for comparison with the experimental results. Good agreement was obtained between the measured and calculated flutter speeds and frequencies, but the agreement on the response at subcritical speeds was less satisfactory. Turbulence in the wind tunnel led to difficulties in taking measurements, and comments are given on these and other problems that arise in determining response characteristics. The model was of a novel construction and its features are described.
Author (ESRO)

N68-24817# Aeronautical Research Council (Gt. Brit.).
A DIGITAL COMPUTER PROGRAM FOR THE THROUGH-FLOW FLUID MECHANICS IN AN ARBITRARY TURBOMACHINE USING A MATRIX METHOD
H. Marsh London HMSO 1968 34 p refs Supersedes N.G.T.E-R-282, ARC-28246, N67-19973
(ARC-R&M-3509; N.G.T.E-R-282; ARC-28246) HMSO: 15s

A detailed description is given of the development of a computer program for analysing the flow through axial, radial and mixed-flow turbomachines. The theory is based on the through-flow analysis given by *Wu* and the equation for the stream function is solved by a matrix method. The theoretical predictions are compared with experiments reported by Jeffs for a low speed axial flow compressor and it is shown that the theory gives a good estimate for the axial velocity profile. Author (ESRO)

N68-24858# Aeronautical Research Council (Gt. Brit.).
LOW-SPEED MEASUREMENTS OF SKIN-FRICTION ON A SLENDER WING
L. A. Wyatt and L. F. East London HMSO 1968 27 p refs Supersedes RAE-TR-66027, ARC-28089, X66-21323
(ARC-R&M-3499; RAE-TR-66027; ARC-28089) HMSO: 12s 6d

Extensive measurements have been made with surface Pitot tubes of the skin friction on the upper surface of a slender wing. The surface Pitot tubes took the form of razor blade segments attached magnetically to the model. This new method of mounting improves on the conventional technique, particularly in coping with a flow whose direction changes with incidence. The results confirm that high levels of skin friction are present beneath a leading edge vortex. The spanwise distributions of skin friction at different chordwise locations were correlated successfully at a given incidence. The sensitivity to yaw of surface Pitot tubes in areas of three-dimensional flow was found to agree with previous determinations in two-dimensional flow. Author

N68-24895# Aeronautical Research Council (Gt. Brit.).
A THEORY OF THE AERODYNAMIC INTERFERENCE BETWEEN A HELICOPTER ROTOR BLADE AND A FUSELAGE AND WING IN HOVERING AND FORWARD FLIGHT
A. R. S. Bramwell and J. B. B. Johnston London HMSO 1968 59 p refs Supersedes RAE-TR-65127, ARC-27224, N67-28140
(ARC-R&M-3514; RAE-TR-65127; ARC-27224)HMSO: £1 5s 6d

A two-dimensional analysis is made to which a correction factor is applied to convert the calculations to the appropriate three-dimensional case. Pressures and forces on circular and square-sectioned fuselages and on wings are calculated for hovering flight and also the corresponding changes of lift on the blade. Large changes of blade lift occur if the blade is close to a fuselage due to the interference by the fuselage of the downwash or normal component of flow. The calculations also show that the interference effects on, and due to, a square-sectioned fuselage are about half as large as those of a circular cylinder whose diameter is the same as the length of the side of the square. The analysis is extended to cover the case of interference between a blade and a lifting wing or tailfin in forward flight. It is shown that the interference between a tailfin and tailrotor can be severe and may result in a large loss of effectiveness of the tailrotor, especially in hovering and low speed flight. Author

N68-24942# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
CONTRIBUTION OF RHEO-ELECTRICAL ANALOGY TO THE CALCULATION OF THE AERODYNAMIC CHARACTERISTICS OF AIRCRAFT IN A STEADY OR UNSTEADY SUPERSONIC FLOW [CONTRIBUTION DE L'ANALOGIE ELECTRIQUE AU CALCUL DES CARACTERISTIQUES AERODYNAMIQUES D'UN AERONEF EN ECOULEMENT SUPERONIQUE STATIONNAIRE OU INSTATIONNAIRE]
Michel Enselme (Ph.D. Thesis—Paris Univ.) 1967 82 p refs In FRENCH; ENGLISH summary *Its* Publ. No. 119
CFSTI: HC $3.00/MF $0.65

The lifting and symmetrical effects of the wing are calculated. Examples are given to show this method of calculation. The method is applied to the calculation of a wing-fuselage combination that cannot be solved numerically without making simplifying

assumptions. The solving principle is considered for interaction problems for which the analogy is particularly well adapted. The principle of calculation of a wing in a cyclic unsteady flow motion is also presented. Author

N68-24951# Royal Aircraft Establishment, Farnborough (England).
SOME DEVELOPMENTS IN AEROFOIL THEORY
D. Kuechemann Mar. 1967 39 p refs
(RAE-TR-67051) CFSTI: HC $3.00/MF $0.65

This is the text of the eleventh Ludwig Prandtl Memorial Lecture. It deals with a subject with which Prandtl's name is forever associated and attempts to show, by means of a number of examples taken from recent developments, various new interpretations and applications of Prandtl's three Main Problems of aerofoil theory. These are meant to demonstrate the continued topicality and importance of Prandtl's problems as well as the need for further work in this field, especially since this has widened considerably with the evolution of a whole spectrum of major types of aircraft. Author

N68-24952# Aeronautical Research Labs., Melbourne (Australia).
INVISCID HYPERSONIC FLOW OVER AXISYMMETRIC POWER-LAW BODIES
H. G. Hornung May 1967 20 p refs
(ARL/A-288) CFSTI: HC $3.00/MF $0.65

Theoretical solutions based on the expansion scheme for large x and large M_∞ are obtained for the asymptotic inviscid flow over axially symmetric bodies of the shape $y/d = (x/d)^m$ in the range $1/2\gamma < m < 1/2$, where blast-wave theory applies as a first approximation. In particular, the second-order terms, which are necessary to satisfy the body boundary-conditions for the normal velocity, are computed. The magnitude of the second-order terms is found to increase from zero at $m = 1/2\gamma$ to infinity at $m = 1/2$. Author

N68-24975# Aeronautical Research Labs., Melbourne (Australia).
HYPERSONIC FLOW OVER POWER-LAW BODIES IN THE NEWTONIAN LIMIT
H. G. Hornung Mar. 1967 25 p refs
(ARL/A-287) CFSTI: HC $3.00/MF $0.65

The hypersonic flow of an inviscid perfect gas over bodies of the shape $y = x^m$ at zero incidence is investigated theoretically in the Newtonian limit. A Newtonian detachment point is found to occur on these bodies if $m < 1/2+j$, j being zero or one for plane or axisymmetric flow respectively. The behavior of the attached shock layer thickness for large streamwise distances gives shock wave shapes which are similar to the body shape, but this occurs only for body powers greater than $2/3+j$. A logarithmic term appears in the shock wave shape at this value of m. In the range $0 < m < 1/2+j$ the transition solution from the free layer to the blast wave analogy is complicated by the appearance of a singularity which arises from the breakdown of the Newtonian limit near the stagnation point. This singularity is thought to be removable by an appropriate solution for the stagnation region. The behavior of the Newtonian solutions fits into the pattern of the asymptotic solutions for general specific heat ratios except for $1/2+j < m < 2/3+j$, where the transition from the attached Newtonian shock layer to the blast-wave solution remains unsolved. Author

N68-25093*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CALCULATION OF AXISYMMETRIC SUPERSONIC FLOW PAST BLUNT BODIES WITH SONIC CORNERS, INCLUDING A PROGRAM DESCRIPTION AND LISTING
Jerry C. South, Jr. Washington May 1968 63 p refs
(NASA-TN-D-4563) CFSTI: HC $3.00/MF $0.65 CSCL 01A

A program for the approximate calculation of supersonic flow of an ideal gas past blunt bodies with sonic corners is described. Numerical solutions are obtained for the system of differential equations derived from the one-strip integral (Belotserkovskii) method. Aerodynamic results of interest include the surface pressure and velocity distributions, the shape and location of the detached bow shock wave, and the forebody pressure drag coefficient. Comparison of the calculations with experimental data is given, with particular emphasis on spherically blunted cones of large apex angle. For this configuration, a simple method is suggested for estimating angle-of-attack pressure distributions. Other shapes included are a circular disk and a spherical cap convex or concave to the stream. The program operation and listing in FORTRAN IV language are given in the appendixes. Author

N68-25346# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
STANDARD BALLISTIC HEADS HB-1 AND HB-2. SUMMARY REPORT ON AERODYNAMIC CHARACTERISTICS FROM MACH 2 TO MACH 16.5 [MAQUETTES ETALONS HB.1 ET HB.2. CARACTERISTIQUES AERODYNAMIQUES MESUREES DANS LES SOUFFLERIES DE L'O.N.E.RA. DE MACH 2 A MACH 16.5]
Rene Ceresuela 1968 25 p refs In FRENCH; ENGLISH summary
(ONERA-NT-123) CFSTI: $3.00/MF $0.65

Standard ballistic heads were tested in hypersonic facilities at Mach numbers from 1.6 to 16.5 in order to compare wind tunnels of different agencies. Force measurements are compared with those published in other countries and the comparisons point out a discrepancy on the normal force and moment gradients for M10. Measured minimum drags exibited a continuity when plotted versus the viscous interaction parameter. Measurements of pressure distribution in hotshot wind tunnels are also reported. Author

N68-25433*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND TUNNEL WALL EFFECTS AT EXTREME FORCE COEFFICIENTS
Harry H. Heyson [1968] 38 p refs Presented at the Intern. Congr. of Subsonic Aeron., New York, 3–6 Apr. 1967
(NASA-TM-X-59742) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The available linearized theory of wall effects for highly deflected wakes is discussed. Sample results of an extension of this theory to curved wakes are included. The primary limitation on the use of the theory is the present inability to adequately estimate the effect of interference gradients on the performance and stability of an arbitrary lifting system. The development of nonlinear theory at the University of Washington and the Boeing Company is discussed and sample results are included. A brief discussion of real-tunnel effects such as ground plane representation and lateral recirculation is also included. Author

N68-25486# Martin Co., Denver, Colo.
SCALE-MODEL WIND-TUNNEL ACOUSTIC DATA
John R. Baratono and Frank A. Smith *In* NRL The Shock and Vibration Bull., No. 37, Pt. 7 Jan. 1968 p 221–252 refs (See N68-25477 14-32)

Boundary-layer acoustic noise data were measured on numerous 7 percent scale-model vehicle configurations during wind-tunnel tests. Sound pressure levels (SPL) were obtained over a Mach range of 0.6 to 1.2 for each of six vehicle configurations over a range of tunnel conditions. For each configuration, from 6 to 10 microphones were installed flush to the external skin surface. These microphone locations were chosen on the basis of both maximum turbulent regions (separated flow) and applicable full-scale equipment locations. Approximately 1500 acoustic plots are

presented, permitting a detailed evaluation of boundary-layer noise for a wide range of conditions. The test model was a 7 percent aeroelastic Titan III booster with six payload configurations: (a) configuration 31, similar to that used in the Titan III HST launch at Cape Kennedy; (b) Titan III with 15-deg half-angle conical nose; (c) configuration 41, similar to that used in the Titan III HST launch at Cape Kennedy (except without protuberances); (d) Titan III with two-man SV-5 orbital vehicle; (e) Titan III with 13-ft-diam, 40-ft cylinder Apollo with launch escape system; (f) Titan III with 13-ft-diam, 20-ft cylinder and Apollo with launch escape system. The microphones used to measure the pressure oscillations were model 714 Photocons; scale-model one-third octave plots cover the frequency range from 160 to 31,500 Hz. Author

N68-25514# Aerospace Corp., El Segundo, Calif.
AERODYANMIC NOISE INVESTIGATION IN A SHORT DURATION SHOCK TUNNEL
David H. Ross *In* NRL The Shock and Vibration Bull. Jan. 1968 p 203–217 refs (See N68-25498 14-32)

A study focusing on the simulation of the aerodynamic noise environment of a booster rocket launch vehicle during the transonic portion of a launch trajectory using a short duration shock tunnel is reported. Configurations tested were 1:30 scale models of the Titan IIIA (cone-cylinder-core only) and the Titan IIIC with both 120 in diameter and 156 in diameter solid rocket motor boosters attached to the core. The method of determining the surface pressure fluctuations on a model during the brief flow in a low speed shock tunnel provided a good simulation of full scale flight conditions. Results correlated well with expectations based upon general continuous flow studies and with comparable flight test results when scaled to the latter conditions. Data obtained from tests on the three Titan III launch booster vehicle configurations indicated that the interaction of the booster-rocket-motor-body bow shock with the core boundary layer led to a small increase in surface pressure fluctuation for locations on the target or open sides, whereas a substantial increase was found on the booster-body sides. For the single open side location, flight test results closely resembled the scaled model results. Dynamic pressure scaling for the pressure fluctuation amplitude appeared to give consistent results. S.C.W.

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N68-24460# Federal Aviation Administration, Washington, D. C. Office of Management Services.
ENROUTE IFR AIR TRAFFIC SURVEY, PEAK DAY FISCAL YEAR, 1966
Everett J. Veregge Sep. 1967 200 p
(AD-667604)

The report summarizes and analyzes fiscal year 1966 peak day data for each center and each terminal facility reporting IFR departures. The data show altitudes and departure times by user and type of aircraft. Also provided are pairs of communities with 10 or more flights between them, and the number of such flights. Author (TAB)

N68-24476*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TRENDS IN REPEATED LOADS ON TRANSPORT AIRPLANES
Thomas L. Coleman Washington May 1968 refs Presented at Symp. on Fatigue Design Procedures, Munich, 16–18 Jun. 1965
(NASA-TN-D-4586) CFSTI: HC $3.00/MF $0.65 CSCL 01C

Statistical loads data collected on piston- and turbine-powered transport airplanes during routine feeder-line, short-haul, and long-haul airline service from 1947 to 1965 are summarized. The data presented pertain to the repeated loads resulting from atmospheric turbulence, maneuvers, airplane oscillatory motions, landing contact, and ground operations. The data for several categories of airplanes are compared to show the trends in the loads with the evolution of the transports. The data are presented in terms of the normal accelerations measured near the center of gravity of the airplanes. It is shown that the distributions of repeated loads for various types of transports exhibit much less variation when expressed in terms of number of occurrences per flight rather than in terms of occurrence per flight mile. Author

N68-24484# Federal Aviation Administration, Washington, D. C. Information and Statistics Div.
SCHEDULED AIR TAXI OPERATORS AS OF OCTOBER 1967
[1967] 70 p
(AD-667603)

Reports received from the FAA regions as of October 1, 1967 revealed that there were 165 scheduled air taxi operators. They operated 685 aircraft, of which 198 were single-engine, 455 were multiengine, 23 were turbine, and 9 helicopters. As of October 1, 1967, scheduled air taxi operators totaled 165, an increase of 42 percent over the 116 reported as of November 1, 1966. In less than four years, these operators have grown from 12 to the present number. The number of aircraft utilized by scheduled air taxi operators during this same period has grown from 72 to 685. Author (TAB)

N68-24498*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
PRELIMINARY FLIGHT EVALUATION OF THE STABILITY AND CONTROL DERIVATIVES AND DYNAMIC CHARACTERISTICS OF THE UNAUGMENTED XB-70-1 AIRPLANE INCLUDING COMPARISONS WITH PREDICTIONS
Chester W. Wolowicz, Larry W. Strutz, Glenn B. Gilyard, and Neil W. Matheny Washington May 1968 77 p refs
(NASA-TN-D-4578) CFSTI: HC $3.00/MF $0.65 CSCL 01C

Stability and control characteristics of the XB-70-1 airplane were evaluated from data obtained during the early phases of the flight-test program at Mach numbers extending to 2.56 and altitudes to 64,700 feet (19,700 meters). Flight-determined stability and control derivatives and dynamic characteristics for three wing-tip configurations were found generally to be in fair agreement with predictions based on wind-tunnel tests and theoretical estimates of structural flexibility effects. The results show the short-period and Dutch roll modes of the unaugmented aircraft to be positively damped for the flight conditions evaluated. The airplane exhibited negative (adverse) values of the aileron-yaw parameter $C_{n_{\delta_a}}$ at Mach numbers above about 0.90, although proverse values were predicted. Positive values were obtained at subsonic speeds, but the flight-measured values were less than predicted. The flight-determined effective dihedral was negative for fully deflected wing tips (65°) and higher than predicted. The combination of negative effective dihedral and adverse aileron yaw was conducive to divergent pilot-induced oscillation tendencies. Flight tests showed a marked reduction in directional stability beyond approximately 2° of sideslip. This nonlinearity was found in wind-tunnel studies to be the result of canard interference. Author

N68-24499*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A SUMMARY OF ROTOR-HUB BENDING MOMENTS ENCOUNTERED BY A HIGH PERFORMANCE HINGELESS-ROTOR HELICOPTER DURING NAP-OF-THE-EARTH MANEUVERS
William J. Snyder Washington May 1968 31 p refs
(NASA-TN-D-4574) CFSTI: HC $3.00/MF $0.65

A brief investigation was recently undertaken to study the flying qualities and structural loads of a hingeless-rotor helicopter, the XH-51N, during nap-of-the-earth maneuvers. This investigation was part of Langley's continuing flight research with hingeless-rotor helicopters. The series of nap-of-the-earth maneuvers was devised primarily to simulate military helicopter operation in a hostile environment where remaining undetected is a necessity. Most of the maneuvers employed are abrupt turns, starts, and stops which require a helicopter with very good maneuverability to perform them effectively. Previous investigations have shown that the cyclic loads of the hingeless rotor can be very high during these abrupt types of maneuvers. Time histories of the rotor-hub bending moments measured during the investigation show that during the abrupt maneuvers a rapid buildup in the cyclic bending moments occurs. This buildup, in most cases, exceeds the assigned endurance limit of the rotor hub to such an extent that the service life of the hub is significantly shortened. These results indicate that any operational hingeless-rotor helicopter utilized for nap-of-the-earth flying must be carefully evaluated with respect to the service life of the rotor system. Author

N68-24662# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A SUMMARY OF RESULTS ON SONIC-BOOM PRESSURE SIGNATURE VARIATIONS ASSOCIATED WITH ATMOSPHERIC CONDITIONS
I. E. Garrick and D. J. Maglieri Washington May 1968 28 p refs
(NASA-TN-D-4588) CFSTI: HC $3.00/MF $0.65 CSCL 01C

This report reviews the most pertinent information obtained in recent years relating to atmospheric effects on the sonic boom and, in particular, includes some results of various flight programs. These atmospheric effects are complex, and a statistical approach appears necessary. The statistics of peak pressures follows approximately a log normal distribution, a result that is indicated by existing theory for pure (sinusoidal) sound. A tabular summary of the flight data gives the standard deviations of pressure peaks relative to nominal calculated values of the mean. Information is included on observed variations of sonic-boom signatures for different types and sizes of airplanes. Measurements indicate that wavelike spatial patterns exist in which peaked and rounded waves may alternate and vary with time. Such variations are shown to be induced by the atmosphere rather than by effects of airplane unsteady motion. The spectral content of some ideal and some measured pressure signatures is exhibited and discussed with reference to peakedness or roundness of the wave. Author

N68-24778# Delta Air Lines, Inc., Atlanta, Ga.
STRUCTURAL INSPECTIONS AND TECHNIQUES FOR OLDER TRANSPORT AIRCRAFT
C. B. Wilder [1968] 24 p
(AD-667142)

Inspection methods discussed include visual, X-ray, and ultrasonic inspection. TAB

N68-24790# Aeronautical Research Council (Gt. Brit.).
TAKE-OFF TESTS ON A TRANSPORT AIRCRAFT INCLUDING THE USE OF A 'SCAT' TAKE-OFF DIRECTOR
C. O. O'Leary, J. N. Cannell, and R. L. Maltby London HMSO 1968 59 p refs Supersedes RAE-TR-66117, ARC-28283, X67-12152
(ARC-R&M-3508; RAE-TR-66117; ARC-28283) HMSO: £1 6s 6d

A large number of take-off tests have been made on a Comet aircraft, with the object of (a) acquiring comprehensive data on undirected take-offs; (b) testing a SCAT take-off director. SCAT is explained in detail and the aircraft installation and test method described. Tests to determine ground effect on lift and on the SCAT Lift Transducer are also described. Undirected and directed take-offs are compared using statistical techniques and the performance of the director under abnormal conditions is discussed. The tests have confirmed that the variability of undirected take-offs is such that an improved pilot aid is needed. The comparison between undirected and SCAT directed take-offs indicates that, although this director did not significantly improve variability, pilot's work load was considerably reduced, especially under abnormal flight conditions. A simple technique has been developed for filming the pilot's eye movements to analyse his scan of the instrument panel and some results are discussed. Author

N68-24816# Aeronautical Research Council (Gt. Brit.).
CALCULATION OF THE RESPONSE OF A FLEXIBLE AIRCRAFT TO HARMONIC AND DISCRETE GUSTS BY A TRANSFORM METHOD
C. G. B. Mitchell London HMSO 1968 34 p refs Supersedes RAE-TR-65264, ARC-27982, X66-20520
(ARC-R&M-3438; RAE-TR-65264; ARC-27382) HMSO: 15s

The equation of motion for a flexible aircraft responding to a step gust is derived, and the relation developed between this and the response to an array of harmonic gusts. A Fourier transform method is used to solve the equation of motion. This allows the rigorous inclusion of indicial effects in both the gust and response aerodynamic forces. As an example the symmetric responses of a flexible slender-wing aircraft in subsonic flight to harmonic and step gusts are calculated. The aircraft is given two rigid and four flexible degrees-of-freedom. Aerodynamic forces are calculated by a lifting surface theory and include unsteady effects. Author (ESRO)

N68-24847# National Gas Turbine Establishment, Pyestock (England).
UNCOUPLED LONGITUDINAL STABILITY AND CONTROL OF CIRCULATION CONTROLLED ROTOR VTOL AIRCRAFT IN HOVER
A. R. Seed 1967 62 p refs
(NGTE-R-297) CFSTI: HC $3.00/MF $0.65

The general equations referring to the uncoupled longitudinal stability are developed for circulation controlled V.T.O.L. aircraft, with results given for the hovering case. The roots of the characteristic equation lead to a stable vertical motion and a generally unstable coupled pitching and longitudinal motion. The unstable motion takes two main forms; giving an unstable oscillation when the system is statically stable, and an exponential divergence when the system is statically unstable. The second type of instability will generally occur when using circulation control to give high lift. The static stability is improved by: (1) reducing rotor thrust coefficient, (2) reducing blade aspect ratio, (3) increasing blade zero lift drag coefficient, (4) increasing number of rotor blades/rotor, (5) increasing dC_L/da effects on blade, (6) decreasing the effective distance between the rotor hub and the c.g. of the system when the system is statically unstable, and vice-versa when the system is statically stable. The dynamic stability besides being dependent on the static stability may be improved by increasing the mass of the rotors and hubs. Author

N68-25185# Federal Aviation Administration, Atlantic City, N. J. Dept. of Transportation.

AN ANALYSIS OF THE HELICOPTER HEIGHT VELOCITY DIAGRAM INCLUDING A PRACTICAL METHOD FOR ITS DETERMINATION Final Report

William J. Hanley and Gilbert Devore Feb. 1968 35 p refs

(NA-67-1; DS-67-23)

A composite summary analysis was made of the height–velocity (H–V) diagram test data obtained from the flight testing of three single engine, single rotor helicopters of varying design characteristics and basic parameters. The purpose of this analysis was to ascertain if a practical method for the determination of the H–V diagram could be evolved, as well as a means to determine the effects of aircraft weight and altitude on thd H–V diagram. Analysis disclosed that H–V diagrams can be developed for any conventional single rotor helicopter by the flight test determination of a singular maximum performance critical speed (V_{cr}) point in conjunction with the use of a nondimensional curve and the solution of specific key point ratios which are set forth in the report. An evaluation of the H–V diagram key point relationships is presented followed by a discussion of the observed factors affecting autorotative landing following power failure. A suggested step by step procedure for deriving average pilot H–V diagrams is also presented. Author

N68-25217 Port of New York Authority, N. Y.

DEVELOPMENT AND ENFORCEMENT OF NOISE STANDARDS

Albert H. Odell Nov. 1966 12 p Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966

(INC/C4/P7)

The concept of aircraft noise level standards is reviewed with a view of implementing the permissible ground noise level of 112 perceived noise decibels. In order to refine the scale for noise duration and for the presence of pure tones such as the discrete frequencies produced by turbofan machines, the author suggests the following guidelines to eliminate the generating of noisier aircraft: (1) determine the maximum noise reduction possible through aircraft and engine design; (2) establish noise criteria to be met for certification in the manufacture and operation of aircraft; and (3) require all existing aircraft to be modified to meet such noise criteria at an early data. G.G.

N68-25278*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FAN V/STOL AIRCRAFT

M. O. Mc Kinney and W. A. Newsom [1967] 44 p refs Presented at the New York Acad. of Sci. Intern. Congr. of Subsonic Aeron., 3–6 Apr. 1967

(NASA-TM-X-59739) CFSTI: HC $3.00/MF $0.65 CSCL 01C

This paper points out some of the fundamental characteristics of fan-powered V/STOL aircraft and demonstrates with various test data how these fundamental characteristics show up in the characteristics of various particular configurations. Since most of the experience with fan-powered V/STOL configurations has been gained in wind tunnels, the emphasis in the paper is on aero-dynamics although some operational data from flight tests are presented. Author

N68-25284# National Lucht-En Ruimtevaartlaboratorium, Amsterdam (Netherlands).

A FEW NOTES ON THE PROBLEM OF SPEED STABILITY

J. Buhrman, F. E. Douwes Dekker, and C. M. Kalkman 7 May 1966 18 p refs Presented at the AGARD Specialists Meeting on Stability and Control, Cambridge, Sep. 1966

CFSTI: HC $3.00/MF $0.65

A survey is given of both theoretical and practical aspects of speed stability. The many factors influencing the behaviour of the aircraft during the instrument approach, prevent a satisfactory prediction of an acceptable approach speed by means of the existing criteria for speed stability. In order to obtain the desired information of speed stability characteristics, both the effects of aircraft and engines are included. A relatively simple flight test was formulated for that purpose, and was applied to seven different aircraft. A discussion of the results is given. Author

N68-25286 Hawker Siddeley Aviation, Ltd., Hatfield (England).

THE EFFECT OF LOW ALTITUDE GUSTS ON AUTOMATIC LANDING

J. C. Hall 6 Sep. 1966 31 p refs Presented at AGARD Flight Mech. Panel Specialists' Meeting—Stability and Control, Cambridge, England, 20–23 Sep. 1966

During the early flight trials of the Trident Automatic Landing System, it was found that the response of the aircraft to head and tail gusts could occassionally give a heavy landing. Little data was available on gusts at low altitude, so the existing aircraft instrumentation was used to provide general data on low altitude gusts. The measured turbulence levels were correlated with reported wind strength, and the data was then combined with information on the frequency of various wind strengths to predict probability distributions of turbulence level. The gust data obtained was then used as the basis of a rig and analogue computer programme to develop improved performance in sophisticated autopilot control laws. Further work is in hand to provide more extensive and reliable data on low altitude gusts during the final proving flying of the automatic landing system. Author

N68-25287# Federal Aviation Administration, Washington, D. C. Systems Analysis Div.

WEATHER ASPECTS OF AIRPORT NOISE AND ITS APPLICATION TO ZONING AND AIRCRAFT OPERATING PROCEDURES

Arthur Hilsenrod [1966] 19 p refs Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966

(INC-C4/P10)

Theories on the propagation of sound through the atmosphere are reviewed. These theories are applied to the propagation of noise from rocket and artillery fire and from sonic booms. A research and development program is recommended to develop criteria on the frequency, duration and intensity of noise levels about an airport for use in land zoning, aircraft operating procedures, and static firing of engines. Author

N68-25292 Department of Housing and Urban Development, Washington, D. C. Metropolitan Area Analysis Div.

THE AIRPORT AND COMPREHENSIVE PLANNING FOR METROPOLITAN DEVELOPMENT

Jonathan B. Howes Nov. 1966 12 p Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966

(INC/C2/P3)

The problem of aircraft noise and the political and institutional impediments to achieving compatible land uses around airports in the United States are discussed. The tools available for controlling land development around airports are identified as the power to plan, zoning, easements, and public ownership. The only short range solution for existing airports is considered to be implementing takeoff and landing procedures which minimize noise impact. Long range solutions include insulation of homes in the vicinity, conversion of land from incompatible to compatible uses, and removal of the noise source or transferring aircraft operations to another site. Land planning and development controls are most effective in the long range planning of new airports; however, the number of new major airports is expected to be small. It is concluded that existing institutions and tools are inadequate to deal with jet age problems. N.E.N.

N68-25293*# National Aeronautics and Space Administration. Langley Research Station, Langley Station, Va.
NASA RESEARCH ON FLEXIBLE WINGS
Francis M. Rogallo [1967] 20 p refs Presented at the Intern. Congr. of Subsonic Aeron., New York, 3–6 Apr. 1967
(NASA-TM-X-59738) CFSTI: HC $3.00/MF $0.65 CSCL 01C

The overall spectrum of flexible wings investigated at the Langley Research Center is presented and the state of the art with regard to maximum lift drag ratios obtained is defined for a wide range of wing configurations. Maximum lift drag ratios above 3.0 were obtained on completely flexible wings; and for cylindrical type flexible wings, values of lift drag ratios up to 17.0 were obtained when the wing had small, tapered rigid leading edges. The flexible wings of most immediate interest are those with no structural stiffening because they have weight, volume, packing, and deployment characteristics potentially as good as those of conventional parachutes, but provide a stable and controllable glide with performance adequate for aerial delivery of cargo and personnel, for landing space capsules, boosters, or hypersonic aircraft, and as emergency wings for aircraft or aircraft escape systems. The high-performance flexible wings at the other end of the spectrum, although not presently of general interest, show promise of becoming light-weight, rugged, stowable wings for applications such as roadable aircraft, flying boats, flying submersibles, cargo tow gliders, a variety of sport gliders, and perhaps advanced recovery systems for boosters and hypersonic aircraft. Author

N68-25296# Technische Hogeschool, Delft (Netherlands).
DETERMINATION OF PERFORMANCE, STABILITY AND CONTROL CHARACTERISTICS FROM MEASUREMENTS IN NON-STEADY MANOEUVRES
O. H. Gerlach Jul. 1966 28 p refs
(M-100; Rept.-4194)

The paper discusses a flight test method to obtain aircraft performance data as well as stability- and control characteristics from measurements in non-steady longitudinal manoeuvres. After a brief exposé of the results to be expected from the method, the analysis of the recorded data is discussed. Special attention is given to the manner in which regression analysis is employed in the evaluation of the data measured in flight. Also a method to determine the angle of attack without any of the usual external sensing devices is mentioned. The high accuracy instrumentation system used is described very briefly. Finally results of a series of flight tests are presented and the repeatability of the results is considered. Author

N68-25313# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INVESTIGATION OF THE EFFECT OF WHEEL BRAKING ON SIDE-FORCE CAPABILITY OF A PNEUMATIC TIRE
Thomas A. Byrdsong Washington June 1968 24 p refs
(NASA-TN-D-4602) CFSTI: HC $3.00/MF $0.65 CSCL 01B

An experimental investigation was made to determine the effects of wheel braking on the side force capability of a pneumatic tire. Data were obtained from tests of a smooth-tread pneumatic tire with an inflation pressure of 30 pounds per square inch at ground speeds of 10, 20, and 30 miles per hour at wheel yaw angles of 4° and 8° on both wet and dry paved surfaces. The results indicate that a considerable amount of side-force capability is available during wheel braking in the slip-ratio range from free rolling to maximum braking force. For additional wheel braking, the side force decreases rapidly to zero at full skid. Author

N68-25322#
METHODS FOR THE REDUCTION OF NOISE CAUSED BY AIRCRAFT AND ENGINES DURING MAINTENANCE OPERATIONS OR TESTING ON THE GROUND
[1966] 3 p Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C6/P5)

It is pointed out that during maintenance operations and testing the engines are run at maximum rating for long periods of time. It is suggested that maintenance areas be located in areas which give the most favorable noise attenuation characteristics and additional protection be provided by banks of earth, inflatable screens, mufflers, and similar attenuators. N.E.N.

N68-25341*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A DISCUSSION OF THE USE OF THRUST FOR CONTROL OF VTOL AIRCRAFT
Seth B. Anderson Washington [1967] 18 p refs Presented at the Flight Mech. Panel of AGARD, Goettingen, West Ger., 11–13 Sep. 1967
(NASA-TM-X-60451) CFSTI: HC $3.00/MF $0.65 CSCL 01C

The use of engine thrust to control VTOL aircraft in hover has been examined to point out the importance of certain items that affect handling qualities. Information is based on the results of NASA-Ames Research Center tests using the piloted six-degree-of-freedom motion simulator and the X-14A variable stability and control aircraft. The discussion includes consideration of the use of thrust vectoring and thrust modulation. The results indicate that thrust vectoring to produce lateral translation can be used satisfactorily, reducing roll angular acceleration requirements. When thrust modulation is used for control, control lags must be minimized to avoid oscillatory tendencies. Author

N68-25342*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUMMARY OF VARIATIONS OF SONIC BOOM SIGNATURES RESULTING FROM ATMOSPHERIC EFFECTS
Domenic J. Maglieri, David A. Hilton, and Norman J. McLeod (NASA. Flight Res. Center) [1967] 24 p refs Presented at the 5th Meeting of the FAUSST, French Anglo-Saxon U. S. Supersonic Transport Comm., Washington, D. C., Feb. 1967
(NASA-TM-X-59633) CFSTI: HC $3.00/MF $0.65 CSCL 01B

Data based on about 5,000 overpressure measurements are presented to illustrate atmospheric induced sonic boom signature variations for supersonic aircraft varying in gross weight from about 20,000 to 450,000 pounds and from about 60 ft. to 185 ft. in length, respectively. Descriptions are included of several special flight test experiments performed to define quantitatively some of these atmospheric effects. The experience derived from several flight test programs regarding sonic boom signature variations has been summarized. Variations were noted to occur in the peak overpressure, the impulse function, the time duration, and the bow wave rise time. Such variations are noted to be induced by the atmosphere. That portion of the atmosphere below about 2,000 ft is shown to be most influential although in some cases the higher portions may also be important. Aircraft motions, in the form of perturbations about the normal flight track, are shown not to contribute significantly to observed sonic boom signature variations at the ground. Author

N68-25361 American Association of Airport Executives, Inc., Wilmington, Del.
METHODS OF REDUCING NOISE FROM AIRCRAFT AND ENGINES WHEN OPERATED FOR MAINTENANCE OR TESTING ON THE GROUND
Francis T. Fox Nov. 1966 25 p Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C6/P4)

Results on aircraft sound abatement studies showed that only a government-industry cooperation program can achieve a quiet engine in the near future. Attainment of land use compatibility adjacent to terminals and a distribution of cost among those who benefit directly from the air transport system are essential in noise reduction developments. G.G.

N68-25362# Air Transport Association of America, Washington, D. C.

TAKEOFF AND LANDING TECHNIQUES TO ACCOMMODATE NOISE ABATEMENT

[1966] 6 p Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C3/P3)

Recommended are the following aircraft noise abatement procedures: (1) a two segment climbout for takeoff; (2) a glide slope to touchdown of not more than 2-1/2° to 3° approach angle; (3) scattering of noise generated off the ends of runways; and (4) testing and evaluation of new schemes to reduce the noise under takeoff and climbout paths. G.G.

N68-25363# British European Airways, London (England). Maintenance Branch.

METHODS OF REDUCING NOISE FROM AIRCRAFT AND ENGINES WHEN OPERATED FOR MAINTENANCE OR TESTING ON THE GROUND AT BRITISH EUROPEAN AIRWAYS BASE, LONDON (HEATHROW) AIRPORT

R. H. Doggett Nov. 1966 13 p Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C6/P9)

Since the reduction of noise with distance follows the inverse square law with some gain due to atmospheric conditions, the author recommends to double the distance between the aircraft operation and the noise source registration. A noise traveling over grass receives additional attenuation when compared with the same sound waves traveling over concreted areas. The location of engine running aprons as far as possible from residential areas decreases noise considerably. G.G.

N68-25379# Royal Aircraft Establishment, Farnborough (England).

A STUDY OF THE LONGITUDINAL BEHAVIOR OF AN AIRCRAFT AT NEAR-STALL AND POST-STALL CONDITIONS

H. H. B. M. Thomas Sep. 1966 42 p refs Presented at the AGARD Conf., Cambridge, England, 20–23 Sep. 1966
(RAE-TM-AERO-953) CFSTI: HC $3.00/MF $0.65

Although it has long been the policy of all authorities, both civil and military, to ensure that safeguards against dangerous stall penetrations were contained in their airworthiness requirements, there has been little intensive study of the general problem. Difficulties experienced with a number of recent aircraft of the "T-tail" configuration have led to a greater awareness and concern about the stall behaviour. The present paper examines the underlying aerodynamic features, which give rise to the problem and their inter-relationship to the aircraft geometry. Special problems, that relate to formulation, measurement and the estimation of the aerodynamic forces and moments, are briefly discussed. Some results of a study of the dynamic behaviour of an aircraft having pitching moment characteristics, which typify those with super-stall tendencies, are discussed. Some questions relating to test-flying procedures are considered in the light of present knowledge. Author

N68-25386# Air Force Dept., Washington, D. C.

U. S. AIR FORCE EXPERIENCE IN REDUCING NOISE IN GROUND RUNUP OPERATIONS

Gary B. Newton [1966] 62 p refs Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C6/P7)

The U. S. Air Force objectives for reducing turbine engine ground maintenance runup noise are stated. A summary of the results of portable suppressor evaluations is given and the advancements made in the state-of-the-art attributable to the emphasis on portability are discussed. The principal problem areas in the development of portable suppressors are reviewed, with particular emphasis given to near-field noise reduction requirements, complexities created by water cooling of exhaust mufflers, restrictions imposed by variety of aircraft configurations and engine sizes, and operational difficulties imposed by equipment tiedown requirements. A description is provided of the basic design of the two acceptable portable suppressors, one for application with afterburning engines and the other with non-afterburning engines. A description is given of the general design and capability of present semi-portable or demountable type ground runup noise suppressors. Author

N68-25435 National Gas Turbine Establishment, Pyestock (England).

THE INFLUENCE OF ADDED NARROW BAND NOISES AND TONES ON THE SUBJECTIVE RESPONSE TO SHAPED WHITE NOISE

T. J. Hargest and R. A. Pinker 1966 11 p refs Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C4/P20)

Experiments on the influence of added narrow band sounds on the subjective assessment of noise were conducted at the N.G.T.E. 1966 Open Week and at the 1966 S.B.A.C. Show, with over two thousand people participating. The results clarify the apparently conflicting observations of earlier workers and show definitely that the presence of a narrow band content can significantly influence the degree of disturbance caused by noise of the type generated by aircraft near an airport. Author

N68-25467 Air Transport Association of America, Washington, D. C.

LEGAL AND RELATED ASPECTS OF AIRPORT LAND USE PLANNING

Lyman M. Tondel, Jr. [1966] 91 p refs Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C2/P8)

The desirability of including airports and their needs in overall community planning is discussed in the context of the rapidly increasing demand for air transportation and the economic importance of such services to the cities, and the extent and effect of the airport noise problem. The establishment and financing of existing civilian jet airports are reviewed, and the noise abatement measurements that are being undertaken are discussed. The safety and economic factors that must be considered in siting and planning new airports are delineated. Legal problems involved in limiting noncompatible land use near airports are examined, with stress laid on the need for granting local governments or governmental agencies extremely flexible powers to deal with complexities. These are defined as the power to acquire property rights, to reappraise properties, and to put properties acquired in fee to revenue-producing use. M.G.J.

N68-25490# Brussels Univ. (Belgium). Inst. of Aeronautics.

STUDY OF CAPTURED OUTPUT OF THE ENTRY OF FLOODED AIR AT TRANSVERSE SYMMETRY BY GROUND EFFECT MACHINE [ETUDE DU RENDEMENT DE CAPTATION D'UNE ENTREE D'AIR NOYEE A SYMETRIE TRANSVERSALE POUR VEHICULE A EFFECT DE SOL]

A. Jaumotte, M. Lejeune, and M. Poellaer 1968 37 p refs In FRENCH
(TN-19) CFSTI: HC $3.00/MF $0.65

Capture efficiency was evaluated for a flooded air inlet of a ground effect machine. Results are described for an environment that simulated the flooded air entry at the bridge of the vehicle and just in front of the pilot's cabin, as well as for a

flooded condition on the roof of the cabin. Conditions were at normal incidence and, in some instances, for incidences other than normal. Also studied was the entry of air at an angle of 90° placed at the center. M.W.R.

N68-25517# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SONIC BOOM: ITS SIGNATURE CHARACTERISTICS
Harry L. Runyan and Domenic J. Maglieri 17 Aug. 1967 21 p refs Presented at the 9th Explosives Safety Seminar, San Diego, Calif., 15–17 Aug. 1967
(NASA-TM-X-60429) CFSTI: HC $3.00/MF $0.65 CSCL 01B

Discussed are the origin of the sonic boom, some of its characteristics, and factors which influence the boom. The three main factors may be classified as aircraft configuration, aircraft operating condition, and observer environment. Changes in aircraft configuration are shown to have a large influence on the boom signature; relatively small geometric changes can have large effects. Of the operating characteristics, it is shown that increasing the altitude has a very large effect in reducing the maximum boom overpressure, but acceleration and maneuvering can cause booms of high magnitude in local areas. The weather environment is also shown by actual measurements to cause large perturbations on the nominal boom signature. Author

N68-25522# American Standards Association, New York.
INDIVIDUAL AND COMMUNITY REACTION TO AIRCRAFT NOISE; PRESENT STATUS AND STANDARDIZATION EFFORTS
W. J. Galloway and H. E. von Gierke Nov. 1966 31 p refs Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C4/P9)

This paper reviews the laboratory and field judgments of individual reactions to aircraft noise, sociological surveys of community reactions conducted in the USA, and socio-economic data used in assessing aircraft noise and establishing noise criteria. The evolution of several planning procedures, culminating in the present Composite Noise Rating for estimating residential community reaction to aircraft noise, is described. Also discussed is the relationship of these procedures to the Noise Number Index used in the United Kingdom and the Ω Exposure Index derived in Germany. The present noise exposure calculation procedures, based on sociological survey data, are compared with the category scale judgments of individuals' acceptability ratings of aircraft noise. The relationship of these procedures to current standardization efforts of the International Standards Organization, the American Standards Association, and the Society of Automotive Engineers is described. Problems of standardization are pointed out. Author

N68-25562# Society of Automotive Engineers, Inc., New York.
OPERATIONS RESEARCH PROGRAM TO DEVELOP LOW NOISE AIR TRANSPORT SYSTEM AT MINIMUM COST
John M. Tyler [1966] 79 p refs Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C2/P5)

In order to develop means for reducing aircraft noise in communities near airports, a study was conducted with attention focused on the design and operation of take off and approach equipment and facilities. An operations research program is described which was designed to determine the least cost methods for reducing aircraft noise to various levels using the results of noise reduction by changes in engines, aircraft, airports, operating procedures and land use in areas near airport runways. Efforts being made to evaluate and develop system changes in take off and landing operations at airports are discussed. Design features and operating procedures are presented which are predicted to permit the air transport system to operate with low community noise levels and high airport traffic levels without interfering with normal growth of the airlines. B.S.D.

N68-25592# Federal Aviation Administration, Washington, D. C.
THE LEGAL SOUND OF AIRCRAFT NOISE
Robert L. Randall [1967] 15 p refs Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C4/P11)

The case law governing liability for aircraft noise is discussed, and two opinions of the Supreme Court are examined to show that the right to compensation is based on the theory of a constitutional taking of property rather than the more obvious annoyance factors. Decisions by state courts and subsequent actions by the Court of Appeals are also reviewed. Existing and proposed legislation in the aircraft noise area is assessed. Two factors standing in the way of legislation are considered to be no agreement as to a universally acceptable way to measure aircraft noise, and the question of who is to pay the cost. It is pointed out that an objective economic evaluation of the benefits and costs of reducing aircraft noise is required so that there can be a proper allocation of the burden. M.G.J.

N68-25599
RESEARCH OF THE SNECMA ON THE REDUCTION OF THE NOISE OF JETS [RECHERCHES DE LA SNECMA SUR LA REDUCTION DU BRUIT DES JETS]
G. Richter [1966] 17 p In FRENCH Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C1/P17)

Longitudinal tubes, retractable silencers, and centrally located blast pipes were studied in terms of reducing the noise from jet aircraft and developing a silencer for the Concorde supersonic jet transport. The theory and the causes of jet noises are discussed, and the principles and aerodynamic-acoustic characteristics of the various type silencers are considered along with their advantages and limitations. Effects of masking noise and wave interactions are also reported. Transl. by M.W.R.

N68-25610 Federal Aviation Agency, Washington, D. C.
SOME PROBLEMS OF COST ALLOCATION TO ALLEVIATE AIRCRAFT NOISE
Ronald W. Pulling and Robert F. Bacon [1966] 17 p Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C2/P4)

Qualitative terms are used to express the cost relationships of the various methods for reducing aircraft noise. Three techniques are considered for noise reduction: (1) the modification of the vehicle; (2) the adjustment of the flight path; and (3) the reduction of noise on the ground by modification of structures or by conversion of the existing land use to uses more compatible with generated noise. Economic benefits and costs associated with each of the techniques are analyzed and then interrelated by use of a cost matrix. Selection of a community noise level acceptance factor, methods of payment, quantification of benefit/cost relationships, and decision making are discussed. The general assumption is that all efforts not involving economic penalty will be made to reduce aircraft noise. The importance of the initial charge assessment to the sector paying the cost is pointed out. K.W.

N68-25618#
KNOWLEDGE OF AIRCRAFT NOISE AND REQUIREMENTS FOR THE APPROVAL OF NEW AIRCRAFT TYPES
[1966] 2 p Presented at the Reduction of Noise and Disturbance Caused by Civil Aircraft Conf., London, Nov. 1966
(INC/C4/P12)

Consideration is given to methods of specifying maximum permissible noise levels, how such levels should be determined, and methods of assessing compliance. Requirements necessary to determine the noise levels on the ground produced by aircraft are defined, and noise requirements for the approval of new aircraft types are listed. B.S.D.

N68-25620#
CONTROL OF AIRCRAFT NOISE BY AIRPORT SITING AND LAYOUT PLANNING
William E. Downes, Jr. [1966] 10 p Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C2/P8)

Control over aircraft noise and its resultant impact upon the community adjacent to an airport can be effected by the selection of the airport site and planning the layout of the facilities to be developed. To a lesser degree, site planning can also minimize the impact of high density operations at existing airports, where improvements or modifications are to be made. Author

N68-25621# Rolls-Royce, Ltd., Derby (England).
THE EVOLUTION OF THE ENGINE NOISE PROBLEM
F. B. Greatrex and R. Bridge [1966] 26 p refs Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C1/P6) CFSTI: HC $3.00/MF $0.65

The airport noise problem, compounded by the steady increase in air traffic and the introduction of jet transport, is examined. Efforts to investigate the noise of turbojet engines are discussed in terms of the basic noise sources, the location of the main sources, the radiation pattern of a typical engine, the noise of the pure jet engine, the type of silencer developed to reduce jet noise on both pure jet engines and low by-pass ratio engines, by-pass and fan engines, predominance of rearwards fan noise, and character of compressor and fan noise. The noise penalty and the alternative penalty for improved specific fuel consumption are considered, along with low noise fan configurations and nozzle area variations. M.G.J.

N68-25628 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
ON THE MEASUREMENT OF THE SPECTRUM OF THE MAXIMUM SOUND PRESSURE GIVEN OFF BY JETS WHEN STATIONARY AND IN FLIGHT [SUR LE CALCUL DU SPECTRE DE PRESSION SONORE MAXIMALE EMIS PAR LES JETS STATIONNAIRES ET EN VOL]
M. Kobrynski [1966] 9 p refs In FRENCH Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C1/P18)

The fundamental parameters of jets and the characteristics of flight trajectories are defined, and an equation is derived for determining the maximum global sound pressure for a given distance of reference (30 m). The acoustic spectrum associated with the sound pressure is calculated to separate the general spectrum of maximum linear sound pressure, determined as a function of height without dimension. This spectrum is represented by a unique curve, for both the stationary and inflight jet, with the coordinates of height without dimension considered as indicated by the theory. This method was experimentally verified, and the precision obtained was found to be ±3 db. M.G.J.

N68-25629# Columbia Univ., New York. School of Public Health and Administrative Medicine.
COMMUNITY REACTIONS TO AIRCRAFT NOISE
Paul N. Borsky [1966] 13 p Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C4/P8)

The need for careful scientific socio-psychological surveys is discussed in the context of their use as a basis for making political and technical decisions on establishing international noise abatement procedures. The developmental work for such social surveys is reviewed, with particular reference to the series of community noise research efforts sponsored by the United States government. It is pointed out that 2300 interviews on military jet aircraft were used to develop a theoretical framework of factors affecting community reactions to aircraft noise as well as to calculate preliminary quantitative findings on reaction to military jets. Similar surveys by other nations are discussed. Details are given on the comprehensive and detailed social survey plan for gathering objective data on community reactions to jet aircraft noise adopted by the Organization for Economic Cooperation and Development. M.G.J.

N68-25635 British Overseas Airways Corp., London (England). Engineering and Maintenance Div.
IMPLICATIONS OF MEASURES TO REDUCE GROUND RUNNING JET ENGINE NOISE AT CIVIL AIRPORTS
[1966] 11 p Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C6/P8) CFSTI: $3.00

Implications of measures taken at London Airport to reduce engine ground running noise, and speculations concerning requirements for future subsonic and supersonic jet aircraft are discussed. Considered are problems arising from noise levels that are unacceptable to people both within and outside of an airport, as for example, London Heathrow which is located near the residential community. Noise reduction techniques used at London Airport for the last ten years, and future areas of research are reviewed. S.C.W.

N68-25636
THE REDUCTION OF NOISE FROM TURBO-JET AIRCRAFT
A. G. Munin [1966] 6 p Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C1/P22)

Active and passive turbojet aircraft noise abatement methods are reviewed. Analyzed are methods for the reduction of noise on the ground during take off; inflight, when landing, and during run-up tests; in the cabin; and the acoustic load on the structure and instruments. Limitations of existing noise abatement techniques, and resulting aircraft design problems of engineers and acousticians are discussed. S.C.W.

N68-25641 Boeing Co., Seattle, Wash.
SOME ASPECTS OF THE DEVELOPMENT OF QUIETER AIRCRAFT
J. B. Large and R. A. Mangiarotty [1967] 18 p Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, 22–30 Nov. 1966
(INC/C1/P16)

Operational techniques and engineering solutions that have been developed to lower the noise from current aircraft are evaluated, and the effect of designing future aircraft to meet criteria imposed by noise is discussed. S.C.W.

N68-25642 Federal Aviation Administration, Washington, D. C.
THE TWO SEGMENT NOISE ABATEMENT APPROACH TO LANDING

Robert B. Meyersburg and Charles H. Williams [1967] 12 p Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C3/P5)

A research program designed to determine the feasibility of using a two segment noise abatement approach to landing that is compatible for use near airports is reported. Noise perceived under the transport as it flies down the approach path to landing which is a function of the thrust of the engines and the height of the engines above the ground is considered. Previously proposed techniques involve steepening of the initial part of the approach path to increase the height of the noise source while at the same time reducing the thrust required and its resultant noise. The two segment approach combines these two noise reduction aspects in a single operational procedure, thus permitting an aggregate reduction in apparent noise level on the ground. Research programs to evaluate piloting problems involved in flying current jet transports using steep approach angles are reviewed, and instrumentation and components of a passive guidance system which was used in these evaluations is described. S.C.W.

N68-25643# Air Line Pilots Association, International, Chicago, Ill.
OPERATIONAL NOISE ABATEMENT PROCEDURES DESIGNED TO LIMIT THE AMOUNT OF DISTURBANCE CAUSED BY AIRCRAFT TAKING OFF, IN FLIGHT, OR LANDING
Harry F. Clark and Harold F. Marthinsen [1967] 23 p Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C3/P8)

Operational noise abatement procedures and the resulting reduction in safety margins are discussed, and possible changes in current noise abatement procedures which can substantially increase the level of safety while still contributing to the reduction of noise are evaluated. Author

N68-25650
MONITORING OF AIRCRAFT NOISE
[1967] 2 p Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C4/P16)

The use of automatic measuring stations in France for monitoring aircraft noise is briefly discussed. It is pointed out that the location of these stations must be characteristic of (1) the airport and in line with a runway, or at a selected respective distance from two runway center lines; (2) the aircraft which use the airport; and (3) the specific operational procedures for take-off and landing paths. M.G.J.

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N68-24356# Naval Ship Engineering Center, Philadelphia, Pa.
A REVIEW OF THE STATE-OF-THE-ART OF FLUIDIC CONTROL Final Report
James W. Banham, Jr. 15 Mar. 1968 19 p refs
(AD-667597)

The report covers a review of the state-of-the-art of fluidics technology, particularly with respect to potential applications to naval machinery control. The discussion covers the progress of development in general terms, with specific examples of current and future developmental applications for ship propulsion systems. Conclusions cover the difficulties that have been encountered in the development of fluidic systems. These include element contamination, impedance matching, and the resulting need for trial and error system design. New concepts for unusual fluidic applications are discussed. Author (TAB)

N68-24366# Royal Aircraft Establishment, Farnborough (England).
A STUDY OF THE ELECTRICAL CHARACTERISTICS OF GAAS P–N JUNCTIONS USED AS SOLAR CELLS [ISSLEDOVANIE ELEKTRICHESKIKH KHARAKTERISTIK GAAS DIFFUZIONNYKH P-N-PEREKHODOV ISPOL'ZUEMYKH V KACHESTRE SOLNECHNYKH ELEMENTOV]
M. B. Kagan, A. P. Landsman, and B. A. Kholev Feb. 1968 13 p refs Transl. into ENGLISH from Fiz. i Tekhn. Poluprov. (USSR), v. 1, no. 6
(RAE-LIB-TRANS-1287) CFSTI: HC $3.00/MF $0.65

A study has been made of the electrical characteristics of GaAs solar cells obtained by various methods of zinc diffusion in n-type GaAs. The nature of the deviations of these characteristics from the Shockley–Noyce–Sah theory is discussed as well as their influence on the photoelectrical parameters of solar cells. Author

N68-24455*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
NIMBUS 2: PHOTOVOLTAIC POWER SYSTEMS ON FLIGHT SPACECRAFT
K. F. Merten, K. L. Hanson, and W. J. Schlotter 23 Feb. 1968 519 p refs
(Contract NAS7-547)
(NASA-CR-62045; Doc.-68SD4222) CFSTI: HC $3.00/MF $0.65 CSCL 10B

Design and performance of the photovoltaic power system in the Nimbus 2 spacecraft are detailed from the viewpoint of the needs of a power system design engineer. Following descriptions of the Nimbus project, the power system, and overall power system management, descriptions are given of the solar array, battery modules, electronics module, and other components. Design performance requirements are detailed in terms of the subsystems, solar array, battery, and electronics module. General environmental test requirements are included; and design qualification and/or acceptance requirements are given for the sensory ring components; stabilization and control subassembly and components; solar array component boards, motor and latching mechanism, platforms, and assembly; and the Nimbus A and Nimbus C spacecraft. The power system design qualification and flight acceptance test programs are detailed; ground test and flight performance are described; and electrical/electronic parts lists are included. Costs and significant technical problems are noted, as are the prediction of space output of the Nimbus 2 solar array and effects of long term storage on the power system. M.W.R.

N68-24461*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CAVITATING PERFORMANCE OF TWO LOW-AREA-RATIO WATER JET PUMPS HAVING THROAT LENGTHS OF 7.25 DIAMETERS
Nelson L. Sanger Washington May 1968 39 p refs
(NASA-TN-D-4592) CFSTI: HC $3.00/MF $0.65 CSCL 10B

Cavitation performance of two jet pumps was evaluated in a closed-loop facility using room-temperature, deaerated water. Objectives of the investigation were to study the cavitation performance of jet pumps having low ratios of nozzle to throat area and to examine methods of cavitation prediction in jet pumps. Experimental performance was obtained with two nozzles operated separately in one test section. Each nozzle was operated at three spacings of the nozzle exit from the throat entrance. At each nozzle

spacing, tests were conducted at four values of secondary-to primary-flow ratio, while secondary (pumped fluid) inlet pressure was varied. Extensive amounts of cavitation were observed before performance was affected. However, when the head ratio deteriorated, it did so quite sharply. For the test section considered in this investigation, a nozzle spacing of approximately one throat diameter best satisfied the two major performance requirements of high efficiency and cavitation resistance. The design of the secondary inlet region was important to jet pump cavitation performance. Smooth hydrodynamic streamlining of this region and a thin nozzle wall at the nozzle exit would reduce cavitation susceptibility. Author

N68-24596*# Pratt and Whitney Aircraft, East Hartford, Conn.
RESEARCH AND DEVELOPMENT OF HIGH-PERFORMANCE AXIAL-FLOW TURBOMACHINERY. VOLUME 1: DESIGN OF TURBINE-COMPRESSOR
P. Bolan, R. Cohen, and W. K. Gilroy Washington NASA May 1968 157 p refs
(Contract NAS3-4179)
(NASA-CR-800) CSCL 10A

An evaluation of candidate Brayton-cycle turbomachinery configurations was conducted. As part of this program, a turbine-compressor incorporating a single-stage axial-flow turbine driving a six-stage axial-flow compressor supported on gas bearings was designed. The gas bearing rotor support system was successfully tested in a gas bearing dynamic simulator. A backup gas bearing system was designed and various experimental investigations were conducted to verify certain areas of the turbine-compressor design in addition to the gas bearing testing. Author

N68-24597*# Pratt and Whitney Aircraft, Philadelphia, Pa.
RESEARCH AND DEVELOPMENT OF HIGH-PERFORMANCE AXIAL-FLOW TURBOMACHINERY. VOLUME 3: DESIGN OF BACKUP GAS BEARINGS
J. T. Mc Cabe, W. Shapiro, and T. Y. Chu Washington NASA May 1968 265 p refs
(Contract NAS3-4179)
(NASA-CR-802) CFSTI: HC $3.00/MF $0.65 CSCL 10A

An evaluation of candidate Brayton-cycle turbomachinery configurations was conducted. As part of this program, a turbine-compressor incorporating a single-stage axial-flow turbine driving a six-stage axial-flow compressor supported on gas bearings. A backup gas bearing system was designed. The design activities included steady-state analysis and time transient rotor support system studies. A satisfactory backup gas bearing system was designed. Author

N68-24615*# Ion Physics Corp., Burlington, Mass.
IMPROVED SOLAR CELL CONTACTING TECHNIQUES Quarterly Report
R. W. Sudbury and K. A. Stirrup Apr. 1968 20 p Prepared for JPL
(Contract NAS7-100; JPL-952144)
(NASA-CR-94715; QR-1) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Work is reported on aluminum and nickel contacted solar cells using high vacuum sputtering technology. Cells were fabricated with both aluminum and nickel contacts, and electrical measurements made. The effect of a temperature cycle after sputtering is reported for aluminum contacted solar cells. Aluminum contacted cells with greater than 10% AMO efficiency are reported for an uncoverslipped CeO_2 antireflected coated cell. Author

N68-24624# Minnesota Mining and Mfg. Co., St. Paul, Minn. Space and Defense Products.
SNAP-23A PROGRAM. PHASE 1: THERMOELECTRIC CONVERTER DEVELOPMENT PROGRAM Quarterly Report, Oct. 1–Dec. 31, 1967
J. V. Wachenheim 31 Dec. 1967 137 p
(Contract AT(30-1)-3824)
(MMM-3824-0017; QR-4) CFSTI: HC $3.00/MF $0.65

During this quarter, fabrication and final assembly of the first Experimental Mockup Converter was completed. The unit was placed on test for a nominal 500-hour period after which shipment will be made to Westinghouse for system integration early in the next quarter. Power output of the first 60-watt converter was below the predicted value. An investigation was started to determine the cause. As an interim measure, plans were made to change the basic thermocouple design configuration to include bonded type P-legs in Experimental Mockup Converter No. 3. This has undergone extensive testing in the SNAP-23A 10-Couple Module Test Program and in the related SNAP-21 Program, Contract AT(30-1)-3691. Heat transfer improvements are required at the spherical cold electrode-to-follower interface in order to reduce temperature drop to the specification level of 30°F maximum. Two approaches have been investigated and have the required capability: use of indium foil at the spherical interface with existing aluminum hardcoated followers, and use of beryllium oxide followers. The first approach will be implemented in Experimental Mockup Converter No. 3, and the latter approach is under investigation for application on the Prototype Mockup Converters. Beryllium oxide material exhibits the ultimate combination of electrical resistance and heat transfer characteristics for the application. Author (NSA)

N68-24687# Hahn-Meitner-Institut fur Kernforschung, Berlin (West Germany).
CHANGE OF ELECTRICAL PROPERTIES OF SI-SOLAR CELLS BY NEUTRON-IRRADIATION [AENDERUNG DER ELEKTRISCHEN EIGENSCHAFTEN VON SI-SOLARZELLEN DURCH NEUTRONENBESTRAHLUNG]
B. Reinicke and K. Zander Mar. 1968 44 p refs In GERMAN; ENGLISH summary
(BMWF-FB-W-68-15) CFSTI: $3.00

Studies were the effects of fast neutrons on p-n-Si solar cells. Exposure to tungsten light (T_V = 2854°K) was used for the study of current-voltage characteristics, transmission efficiency, short circuit current, and open circuit voltage as a function of the irradiation. The quantum efficiency was calculated on the basis of spectral photosensitivity. To explain values greater than unity (<1.25), the existence of electrical fields in the base region must be assumed. The strength of this field is calculated by an improved diffusion model. The damage factor of the diffusion length is evaluated and compared with the results of other investigators. K.W.

N68-24757*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INJECTION START OF A BRAYTON CYCLE TURBOCOMPRESSOR OPERATING ON GAS BEARINGS IN A CLOSED LOOP
Robert Y. Wong, Robert C. Evans, Donald J. Spackman, and Charles H. Winzig Washington May 1968 30 p refs
(NASA-TM-X-1590) CFSTI: HC $3.00/MF $0.65 CSCL 10B

A Brayton cycle turbocompressor was experimentally investigated to determine whether the gas bearings could withstand the transients associated with a space start using gas injection. Of the two injection methods studied, constant flow injection and bottle injections, the constant flow injection method imposed a lower thrust load on the turbocompressor during injection. It was also observed that the turbocompressor unit was able to withstand the transients during start, shutdown, and accidental compressor surge. A compressor bypass valve proved to be capable of effecting emergency shutdown without causing severe vibrations. Author

N68-24798# Deutsche Versuchsanstalt fuer Luft- und Raumfahrt, Lampoldhausen (West Germany). Inst. fuer Chemische Raketenantriebe.
DESIGN, CONSTRUCTION AND OPERATION OF STEAM GENERATORS, BASED ON LIQUID PROPELLANT ROCKET

ENGINES, FOR EJECTOR STAGES OF ALTITUDE SIMULATING TEST STANDS [ENTWICKLUNG VON RAKETEN-DAMPFERZEUGEN FUER ABSAUGEEJEKTOREN VON HOEHENPRUEFSTAENDEN]

J. R. Fabian Bad Godesberg, West Ger. Bundesmin. fuer Wiss. Forsch. Mar. 1968 62 p refs In GERMAN; ENGLISH summary (BMwF-FB-W-68-23) CFSTI: HC $3.00/MF $0.65

A considerable amount of steam is needed to operate the ejector stages of rocket altitude simulating test stands. In 1963 DVL decided to develop steam generators based on liquid propellant rocket engines; only in this manner the time-scale could be realized with extremely low investment costs. In the report the following features are described: principle of procedure, fundamentals of calculation, programming of operating steps and test- and operation results of steam generators with capacities of 10, 15 and 115 t/h at 21 atm and 250°C, which are used to operate the ejector stages of the four rocket altitude simulating test stands for testing the third stage of the launch vehicle Europe 1 in the ELDO-program. Author

N68-24838# Commissariat a l'Energie Atomique, Saclay (France).

STUDY OF SUPERSONIC RADIAL NOZZLES FOR MHD CONVERTERS [ETUDE DES TUYERES RADIALES SUPERSONIQUES POUR LES CONVERTISSEURS MHD]

B. A. Tikhonov and V. R. Shevchenko 27 May 1967 19 p Transl. into FRENCH from Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoj Energii SSSR Rept. IAE-1347 In FRENCH (CEA-TR-R-1902; IAE-1347) CFSTI: HC $3.00/MF $0.65

The results of studies on the dynamics of gases in supersonic radial nozzles were reported. The experimental data on the effects of the principal geometric dimensions of the radial nozzle on its gas dynamic characteristics were given. Suggestions were made on the construction of radial nozzles with a uniform field of flow at the output. Author (NSA)

N68-24917*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

MARS SPACECRAFT POWER SYSTEM DEVELOPMENT Interim Report

J. Hayden, A. Kirpich, R. Pellmann, and M. Read 25 Apr. 1968 109 p Prepared for JPL (Contracts NAS7-100; JPL-952150) (NASA-CR-94763; Doc.-68SD4251) CFSTI: HC $3.00/MF $0.65 CSCL 10B

A study to recommend possible changes in existing Mariner power system designs for use in future Mars flyby and orbiter missions developed the following results: (1) A shunt regulation system for further studies; (2) the evaluation of silver–zinc and nickel–cadmium batteries as most promising; (3) no clearcut reliability advantage for fault sensing the regulator and inverter separately or as a pair; (4) the fault criteria for power conditioning units; (5) no change in the used frequency of 2.4 kHz; (6) the development of general guidelines and design practices for power switching and distribution; and (7) problem identifications and alternate approaches for power system circuits. G.G.

N68-24921*# General Precision, Inc., Glendale, Calif. Librascope Group.

RESEARCH AND DEVELOPMENT OF SOLAR CELL CONTACTS Quarterly Progress Report, 1 Jan.–31 Mar. 1968

15 Apr. 1968 39 p refs Prepared for JPL (Contracts NAS7-100; JPL-952145) (NASA-CR-94800; QPR-1) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The cold substrate deposition process is discussed and analyzed in order to establish optimum conditions for the formation of an ohmic aluminum contact to n-type silicon. A deposition technique with aluminum ions having a maximum energy on the order of 200 ev achieved adherent films to p-type wafers. Aluminum was deposited on the unheated chemically clean p-type silicon wafer from partially ionized aluminum vapor. The preliminary glow discharge cleaning process was eliminated. The characteristics of the contact displayed a linear current-voltage relationship. G.G.

N68-24970# Royal Aircraft Establishment, Farnborough (England).

THE SPECTRAL ENERGY DISTRIBUTION OF SUNLIGHT IN MALTA

M. W. Walkden Sep. 1967 31 p refs (RAE-TR-67248) CFSTI: HC $3.00/MF $0.65

An account is given of the measurement of sun and sky radiation in Malta on 2, 3 and 4 of July 1966, as part of a study of the effects of electron damage on the performance of silicon solar cells. The optical apparatus, its calibration, and the method of deriving the spectral energy distribution, are described. Sunlight curves measured on the three days and variations during the day are presented. From the solar cell calibrations and the spectral data, the factor K, relating the mean short circuit current in Malta sunlight (100 mW cm^{-2}) to that in sunlight above the atmosphere, is derived and found to vary from 1.26 for unirradiated silicon cells to 1.24 for cells subjected to 10^{16} electrons/cm^2 at 1 or 2 MeV. Author

N68-25011*# Monsanto Research Corp., Dayton, Ohio.

SILVER–ZINC BATTERY SEPARATOR MATERIAL DEVELOPMENT Quarterly Progress Report, 1 Jan.–31 Mar. 1968

I. O. Salyer, E. V. Kirkland, and P. H. Wilken 10 Apr. 1968 18 p Prepared for JPL (Contracts NAS7-100; JPL-951966) (NASA-CR-94785; QPR-3) CFSTI: HC $3.00/MF $0.65 CSCL 10C

Membranes for use as silver–zinc battery separators are being made of a copolymer of ethylene and acrylic acid which is formed by hydrolysis of vulcanized copolymer film of ethylene and methyl acrylate. Films made from copolymer with different proportions of monomers are being evaluated and optimum methods of vulcanizing, forming film and hydrolysis are being determined. The degree of vulcanization has been found to be a critical variable and must be controlled by means of vulcanizing temperature, amount of vulcanizing agent and vulcanizing time. Polyblending and carbon filling appear to be useful techniques for battery separators. Sterilization at 140°C for 60 hours (40% KOH) has generally caused a small increase in the resistance of the membranes. However, the increase is small and the specific resistance of several membranes has been less than 10 ohm-in. before and after sterilization. Author

N68-25059*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THERMAL PERFORMANCE OF A RHENIUM NIOBIUM CYLINDRICAL THERMIONIC CONVERTER

R. M. Williams and W. J. Bifano Washington May 1968 26 p refs (NASA-TN-D-4582) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Efficiency and steady state performance were measured for a cylindrical thermionic converter having a rhenium emitter and a niobium collector. Measurements were made at the cesium-reservoir temperatures at which peak output power was obtained from emitter temperatures in the range from 1873° to 2073°K and collector temperatures in the range from 850° to 1050°K. Increasing the emitter temperature from 1873° to 2073°K resulted in increasing the maximum electrode efficiency from 0.127 to 0.144. The output power at maximum efficiency increased from 5.7 to 9.2 W/cm^2. For fixed emitter temperatures, the emitter-to-collector heat flux increased linearly with current at the rate of 2.10 W/A. Author

N68-25097*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

DESIGN, DEVELOPMENT AND DEMONSTRATION OF A WARM GAS DISTRIBUTION SYSTEM Quarterly Report, Period Ending 31 Mar. 1968

C. C. Rich, W. D. Boyce, T. E. Hagan, G. H. McBride, and J. J. Gergle 15 Apr. 1968 22 p Prepared for JPL

(Contracts NAS7-100; JPL-951988)

(NASA-CR-94762; Doc.-68SD4254) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Progress during the third three-month period of a program to design, develop, and demonstrate a warm gas distribution system for use with a hydrazine-fueled gas generator to provide spacecraft attitude control torques is reported. Activity during this reporting period was concentrated in component test and system assembly. Author

N68-25098*# Ion Physics Corp., Burlington, Mass.

IMPROVED SOLAR CELL CONTRACTING TECHNIQUES

R. W. Sudbury and K. A. Stirrup Apr. 1968 19 p Prepared for JPL

(Contracts NAS7-100; JPL-952144)

(NASA-CR-94768; QR-1) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Work is reported on aluminum and nickel contacted solar cells using high vacuum sputtering technology. Cells were fabricated with both aluminininum and nickel contacts, and electrical measurements made. The effect of a temperature cycle after sputtering is reported for aluminum contacted solar cells. Aluminum contacted cells with greater than 10% AMO efficiency are reported for an uncoverslipped CeO_2 antireflected coated cell. Author

N68-25105*# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.

SEPARATOR DEVELOPMENT FOR A HEAT STERILIZABLE BATTERY Quarterly Report, 1 Jan.–31 Mar. 1968

L. C. Scala and G. D. Dixon 31 Mar. 1968 12 p Prepared for JPL

(Contracts NAS7-100; JPL-951525)

(NASA-CR-94766; QR-7) CFSTI: HC $3.00/MF $0.65 CSCL 10C

Dip coating of Webril support tape was found to be feasible; when this procedure was used on a commercial foil coating tower, relatively long runs of satisfactorily coated tape were obtained. In the presence of a wetting agent, coated tapes were obtained which exhibited satisfactory resistivity and resistance to sterilization in hot caustic. Polarographic analysis indicated that diffusion of silver ions through separator membranes obtained as described above is generally negligible. Author

N68-25234*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIENCE IN INVESTIGATION OF COMPONENTS OF ALKALI-METAL-VAPOR SPACE POWER SYSTEMS

Robert E. English and Ruth N. Weltmann [1968] 16 p refs Presented at the Symp. on Alkali Metal Coolants—Corrosion Studies Sys. Operating Experience, Vienna, 28 Nov.–2 Dec. 1966; Sponsored by the Intern. Atomic Energy Agency

(NASA-TM-X-59568) CFSTI: HC $3.00/MF $0.65 CSCL 10B

Heat transfer to boiling potassium was investigated in a 300 kW loop of L-605 for temperatures as high as 1750°F and in a 150 kW loop of Cb-1Zr for temperatures as high as 2100°F. In addition, heat transfer to boiling sodium was investigated in a 500 kW bimetallic loop of Cb-1Zr and 316 stainless steel; the boiling temperature reached 2000°F. Condensation of potassium at temperatures of 1200°–1500°F was investigated in two loops of 50 and 150 kW capacity. Wet potassium vapor at 1500°F was produced by a 3 MW gas-fired boiler and supplied to a 2-stage turbine; although the entire loop was built of 316 stainless steel, the turbine rotor blades were of TZC, TZM, and Udimet 700 for purposes of comparison of erosion resistance. Condition of the turbine at the end of an endurance run of 5000 hours is described. Alkali metals at 1100° and 1980°F were pumped for several thousand hours by, respectively, a motor-driven centrifugal pump designed for flight and an electromagnetic induction pump; the pump designs are described. Both electrical and magnetic materials for long-time use at 1100°F have been investigated; results of these tests are presented. The methods used for measurement of fluctuating pressure in these alkali metal systems are also described.

N68-25280*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FREQUENCY RESPONSE OF A FORCED-FLOW SINGLE-TUBE BOILER

Robert G. Dorsch 1967 20 p refs Presented at Technol. Univ. of Eindhoven-EURATOM Symp. on Two Phase Flow Dyn., The Neth., 4–9 Sept. 1967

(NASA-TM-X-60523) CFSTI: HC $3.00/MF $0.65 CSCL 13A

The frequency response of a pump-fed single-tube heat exchanger boiler employing Freon 113 as the boiling fluid and hot water as the heating fluid was determined experimentally. An electro-hydraulic servo-valve was used to impose quasi-sinusoidal perturbations on the mean flow into the boiler. Frequencies between 0.04 and 4 Hz were employed. Inlet pressure and flow perturbations were measured with dynamic pickups. A transfer function analyzer was used to obtain the amplitude and phase of each pressure and flow response. From this data the boiler inlet impedance as a function of frequency was determined for a variety of steady state operating conditions. Data were obtained with two boiler tube configurations: a hollow tube, and a tube with a spring-plug insert to swirl and turbulate the flow. The boiler inlet impedance plots indicate that feed-system coupled instabilities will occur at many of the steady state operating conditions if sufficient feed-system stabilization is not provided. Author

N68-25297# California Univ., Livermore. Lawrence Radiation Lab.

SELF-GENERATING BRAYTON CYCLE PERFORMANCE MODEL

Horst P. Richter 15 Dec. 1967 44 p refs Presented at the 13th Ann. Intern. Gas Turbine Conf. and Prod. Show, Washington, D. C., 17–21 Mar. 1968

(Contract W-7405-ENG-48)

(UCRL-70827; CONF-680306-1) CFSTI: HC $3.00/MF $0.65

A mathematical model is described which permits the performance analysis of advanced Brayton cycles as used in turbine engines for stationary and flight power plant applications. The model permits the performance evaluation of different working fluids, provides for various component combinations, and facilitates exchange of parameters and variables for off-design point performance and trade-off studies. The concept of entropy production is used for expressing the losses (irreversible effects, efficiencies) occurring in components of turbine engines. The derived equations permit the use of specific heat as a function of temperature in energy, entropy, and mass flow relations and establish a consistent set which facilitates the generalized performance analysis. Examples related to open and closed Brayton cycles are discussed. Two significant relationships are obtained for the evaluation of working fluids. Author (NSA)

N68-25304*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

TRANSIENT THERMODYNAMIC ANALYSIS OF A FUEL-CELL SYSTEM

William Emile Simon Washington, D. C. Jun. 1968 89 p refs

(NASA-TN-D-4601) CFSTI: HC $3.00/MF $0.65 CSCL 10A

This report presents a transient thermodynamic analysis of a fuel-cell system exclusive of cryogenic supply system and

external heat dissipation system. The results of a simplified analysis and of a more general analysis are compared, and the results of the more general analysis are compared with performance test data. The analysis is oriented toward a particular application, but the methods employed are sufficiently general to allow application of these concepts to most fluid-loop systems involving heat and mass transfer. Author

N68-25446*# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.
DEFINITION OF A RESISTOJET CONTROL SYSTEM FOR THE MANNED ORBITAL RESEARCH LABORATORY. VOLUME 1: SUMMARY Final Report
A. Pisciotta, Jr. and E. N. Eusanio May 1968 60 p refs
(Contract NAS1-6702)
(NASA-CR-66600; DAC-58130) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Summary data are presented on the results of a program to define CMG/Resistojet attitude control and orbit keeping system and develop and test 10 mlbf NH_3 and H_2 resistojets. The evaluations conducted resulted in the selection and definition of (1) the J-2S engine for orbit injection, (2) a 10 mlbf NH_3 resistojet system for CMG desaturation and orbit keeping, and (3) a 10 lbf N_2H_4 monopropellant system for control of docking disturbances and centrifuge operation. The biowaste utilization evaluation showed the competitiveness of using EC/LS outputs in resistojets, even when compared to systems using closed loop EC/LS systems. A resistojet operable with either NH_3 or H_2 was developed and cyclic tested yielding high performance and electrical efficiency. A program plan for demonstrating resistojet system operational capability was formulated. Author

N68-25447*# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.
DEFINITION OF A RESISTOJET CONTROL SYSTEM FOR THE MANNED ORBITAL RESEARCH LABORATORY. VOLUME 2: RESISTOJET CONTROL SYSTEM ANALYSIS Final Report
A. Pisciotta, Jr. and E. N. Eusanio May 1968 261 p refs
(Contract NAS1-6702)
(NASA-CR-66601; DAC-58131) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Data are presented on the integrated NH_3 resistojet/control moment gyro system and the N_2H_4 monopropellant system selected for the baseline Manned Orbiting Research Laboratory (MORL). The orbit injection system and other interfacing systems are defined in sufficient depth to ensure mutual compatibility between systems. Parametric analysis which led to the selection of the defined systems are also presented. Author

N68-25448*# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.
DEFINITION OF A RESISTOJET CONTROL SYSTEM FOR THE MANNED ORBITAL RESEARCH LABORATORY. VOLUME 3: BIOWASTE UTILIZATION Final Report
A. Pisciotta, Jr., R. V. Greco, and R. M. Byke May 1968 54 p refs
(Contract NAS1-6702)
(NASA-CR-66602; DAC-58132) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The NASA MORL, with a six-man crew, was used to define candidate biowaste resistojet systems and to provide criteria for system selection. Quantities of biowaste H_2, CO_2, and fecal-water outputs were established, and chemical analyses were performed. The H_2 had sufficient oxidizing contaminants to require its operating-temperature limit to be set the same as that for the CO_2 and fecal-water propellants (3000°R). Collection method and pressure were established for each biowaste output. For MORL impulse requirements of 8321 N-sec/day (1870 lbf-sec/day), biowaste resistojet-control systems were defined, and weight, power, and volume comparisons were performed. A biowaste CO_2 system was established as the most advantageous and showed significant gains when compared to similar H_2 and NH_3 resistojet systems. An evaluation to assess the effect of closed-loop EC/LS system capability showed that the biowaste system (with open-loop EC/LS system) remained competitive with the H_2 and NH_3 systems (with closed-loop EC/LS systems). Author

N68-25449*# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.
DEFINITION OF A RESISTOJET CONTROL SYSTEM FOR THE MANNED ORBITAL RESEARCH LABORATORY. VOLUME 4: GROUND AND FLIGHT TEST PLAN Final Report
R. V. Greco May 1968 118 p refs
(Contract NAS1-6702)
(NASA-CR-66603; DAC-58133) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The ground- and flight test program plan is defined to demonstrate operational capability for an NH_3 and H_2 resistojet control system. Scope, cost, and duration are specified. The flight test program was established to provide maneuvering demonstrations, system maintenance (by astronaut EVA) demonstration, and firing demonstrations (170 days). Resistojet thrustor modules will be recovered for post-test evaluation and inspection to determine operational life. Ground-test programs through qualification were established for the resistojet thrustor module and critical components. An integrated-system test program was defined to demonstrate system flightworthiness. Preliminary qualification requirements were determined for all system components. Author

N68-25450*# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.
DEFINITION OF A RESISTOJET CONTROL SYSTEM FOR MANNED ORBITAL RESEARCH LABORATORY. VOLUME 5: RESISTOJET DESIGN AND DEVELOPMENT Final Report
R. J. Page (Marquardt Corp., Van Nuys, Calif.), R. A. Short (Marquardt Corp., Van Nuys, Calif.), and R. V. Greco May 1968 147 p refs Prepared in cooperation with Marquardt Corp., Van Nuys, Calif.
(Contract NAS1-6702)
(NASA-CR-66604; DAC-58134) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Summary of the design, fabrication, and performance testing of 10-mlbf resistojet thrustors for the Manned Orbiting Research Laboratory (MORL). Specific impulses of up to 750 and 340 sec were measured for H_2 and NH_3, respectively. Design criteria, material selection, heat-transfer analyses, gas-dynamics analyses, fabrication methods, testing procedures, and test results are presented. Author

N68-25619*# Thermo Electron Engineering Corp., Waltham, Mass.
APPLIED THERMIONIC RESEARCH Quarterly Progress Report, 4 Dec. 1967–4 Mar. 1968
F. Fraim, E. P. Gyftopoulos, G. N. Hatsopoulos, F. Holly, D. Lieb et al 4 Mar. 1968 113 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952184)
(NASA-CR-94764; TE-4092/3-123-68; QPR-1) CFSTI: HC $3.00/MF $0.65 CSCL 10A

An experimental study is described in which the objective was to determine the behavior of cesium oxides as electronegative additives, and to achieve practical methods for controlling them. Two areas of activity were involved; (1) mass spectrometry and differential thermal analysis to identify chemical species and determine their properties, and (2) diodes to evaluate surface effects and thermionic performance. From the standpoints of thermodynamics and quantum mechanics, the relation between

surface orbital electronegativity and work function was analyzed. The construction and testing of a guard-ring converter with molybdenum collectors and a nominally single tungsten emitter are also reported. In order to understand the behavior of the bulk material under various mechanical thermal treatments, the microstructure and preferred orientation of vapor-deposited tungsten from fluoride and chloride compounds, were studied after exposure to various heat treatments in a vacuum. The computer program for plasma analysis was reviewed with particular attention devoted to the boundary conditions at the emitter and collector sheaths. B.S.D.

N68-25622*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SILICON SOLAR CELLS FOR NEAR-SUN MISSIONS

J. V. Foster, A. C. Wilbur, D. C. Briggs (Philco Corp., Palo Alto, Calif.), and S. Friedlander (Electro-Opt. Systems, Inc.) [1967] 30 p refs Presented at the IEEE Photovoltaic Specialists Conf., Cocoa Beach, Fla., 28–30 Mar. 1967

(Contracts NAS7-409; NAS2-3613)

(NASA-TM-X-59774) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Described is a silicon solar cell concept suitable for Pioneer spacecraft near sun missions. The system utilizes a despun heat shield with an adjustable width slot for exposing the solar cell to the sun as the spacecraft approaches. Evaluation of selective interference filters and reflective coatings during simulated spacecraft runs show that narrow band and high cutoff filters provided good thermal control and a relatively good power output. It is concluded that optimal design and fabrication techniques for silicon solar cells can lead to an improved performance over the usual 1-sun design. G.G.

N68-25624*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPARISON OF N-ON-P CELLS AND LITHIUM CONTAINING P-ON-N CELLS

Joseph Mandelkorn [1967] 15 p refs Presented at the 6th IEEE Photovoltaic Specialists Conf., Cocoa Beach, Fla., 28–30 Mar. 1967

(NASA-TM-X-59749) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The electrical and radiation damage resistance characteristics of solar cells were studied on lithium doped p-on-n cells and n-on-p cells. The relative rapid degradation of the lithium cells after electron bombardment was attributed to an extremely high rate of carrier removal damage. Carrier removal increased the resistance of the body of the cell and degraded open circuit voltage and curve power factor; this damage did not anneal at temperatures up to 200°C. G.G.

N68-25640*# National Aeronautics and Space Administration, Washington, D. C.

NASA WORK ON HIGH-ENERGY-DENSITY ELECTROCHEMICAL POWER DEVICES

Ernst M. Cohn [1967] 9 p Presented at a Meeting on Electron., Apr. 1967

(NASA-TM-X-59782) CFSTI: HC $3.00/MF $0.65 CSCL 10C

Electrochemical research and development efforts directed towards providing reliable, high energy and high power density subsystems for space are summarized. Studies of organic electrolyte systems for batteries; alkaline batteries (zinc-oxygen cells); auxiliary power supply systems and test procedures; and potential cathodic electrocatalysts (alloys) for fuel cells; are reported. S.C.W.

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N68-24354# RAND Corp., Santa Monica, Calif.

NEURAL ORGANIZATION IN THE PRIMATE RETINA

R. J. Mac Gregor Nov. 1967 86 p refs

(Contract DAHC15-67-C-0141; ARPA Order 189-1)

(RM-4912-ARPA; AD-667244)

A survey is presented of the neurohistological, neuroelectrical, and neurophysiological data relevant to retinal organization. The data are derived from studies of the neural organization of the primate retina. Major current problems include mechanisms of adaptation, spontaneous activity, and efferent influence, details of interconnection patterns, and amacrine function. A theoretical framework for an initial consideration of retinal organization is developed and a model that attempts to account for the properties of graded potentials in the external plexiform layer is presented. The model specifies a hypothetical mechanism as the fundamental source of logarithmic intensity encoding. Author (TAB)

N68-24369*# Public Health Service, Cincinnati, Ohio. Food Protection Research.

ECOLOGY AND THERMAL INACTIVATION OF MICROBES IN AND ON INTERPLANETARY SPACE VEHICLE COMPONENTS Quarterly Progress Report, 1 Jan.–31 Mar. 1968

Robert Angelotti 31 Mar. 1968 19 p ref

(NASA Order R-36-015-001)

(NASA-CR-94681; QPR-12) CFSTI: HC $3.00/MF $0.65 CSCL 06M

Previous dry heat resistance studies of *Bacillus subtilis* var. *niger* spores impregnated in filter paper indicated that a wet heat kill mechanism was involved as evidenced by a z_D of 12.9°C. Because sufficient water remained in the system to effect a wet heat system during the drying process, lyophilization was investigated as an improved drying method. D and z values for spores on paper dried by lyophilization are reported. An unusually high z_D value (32.0°C) was previously reported for spores located between steel washers mated at 150 inch-pounds of torque. An explanation for this high value is presented which is based on the slow loss of spore moisture to the hot gaseous environment in the TDT tube during heating. Sealing the mated surface units with epoxy resin prevented loss of moisture and resulted in a z_D value of 21.9°C which was comparable to that observed for the same spores heated in lucite, epoxy, and on stainless steel strips. The rate at which dried spores absorb water from a humid environment and the effects of such absorption on thermal resistance was also studied. Results indicated that the spores did absorb water and that the thermal resistance was increased in proportion to the increased spore moisture content. Also developed was a dry heat exposure system employing spores embedded in epoxy resin. This system will be used to determine the effect of a_w on z values. Results were comparable to those reported for spores embedded in lucite. S.C.W.

N68-24427# Rome Univ. (Italy).

STUDY OF THE ACTION MECHANISM OF IONIZING AND ULTRAVIOLET RADIATIONS IN VITRO CULTURES OF MAMMALIAN CELLS [STUDIO DEL MECCANISMO D'AZIONE DELLE RADIAZIONI IONIZZANTI ED ULTRAVIOLETTE NELLE CELLULE DI MAMMIFERO IN COLTURE IN VITRO] Annual Report, 1 Nov. 1965–30 Oct. 1966

Brussels EURATOM Mar. 1968 24 p refs

(Contract EURATOM-036-64-6-BIOI)

(EUR-3906.I) CFSTI: HC $3.00/MF $0.65

During the research group's second year of work on the combined effects of ionizing (X-rays) and non-ionizing (ultraviolet rays) radiation in *in vitro* cultures of mammal cells, experimental activity was principally devoted to furthering the following investigations: (1) relations between exposure doses and cell survival at various wavelengths, extending the investigation to wavelengths of 2520 Å and 3010 Å; and (2) relative efficiency of the four wavelengths under study with equal exposure doses in producing

changes in the duration of the various phases of the cell cycle, and in inducing chromosomal aberrations during the various phases of the cell cycle, as well as during a whole cell cycle. Experiments continued on the action of 8-methoxypsoralene activated by UV light (3650 Å), with particular reference to: (1) the effects in inducing chromosomal aberrations in various cell strains (Chinese hamster human amnion); and (2) release between irradiated cell-cycle phases and sensitivity to the induction of chromosomal aberrations. Author

N68-24550# Joint Publications Research Service, Washington, D. C.
SPACE BIOLOGY AND MEDICINE, VOLUME 2, NUMBER 1
24 May 1968 137 p refs Transl. into ENGLISH from Kosmich. Biol. i Med. (Moscow), v. 2, no. 1, 1968 p 1–90
(JPRS-45483) CFSTI: HC$3.00/MF$0.65

A Russian-language periodical dealing with space medicine and biology was translated. Articles include studies on animals and humans subjected to space environments, physiological functioning during bed rest, human tolerance to long periods of isolation, and radiobiological data in relation to astronaut shielding. Other studies deal with the otolith functioning during weightlessness, acceleration effects on man, spatial orientation and its disruption, and stability maintenance by man under difficult experimental conditions. M.W.R.

N68-24556*# Scripta Technica, Inc., Washington, D. C.
CLASSIFICATION OF POSTURAL REFLEXES [KLASSIFIKATSIYA USTANOVOCHNYKH REFLEKSOV]
G. L. Komendantov NASA May 1968 9 p refs Transl. into ENGLISH from Vorp. Aviats. Med., Normal'n. i Patol. Fiziol., Tsentr. Inst. Usoversh. Vrachey Press, Moscow, 1966 p 130–137
(Contract NASw-1694)
(NASA-TT-F-11616) CSCL 06P

Consideration of various types of postural reflexes and existing classifications of them, notably a classification proposed in 1924 by Magnus, and a classification of labyrinth postural reflexes developed by de Kleyn and Versteegh. An augmented classification is proposed, covering various groups of postural, compensatory, and extensor reflexes both conditioned and unconditioned. Author

N68-24635 Joint Publications Research Service, Washington, D. C.
COSMIC FLIGHT WATCH-STANDING AND PSYCHO-PHYSIOLOGICAL RHYTHMS
A. A. Leonov and V. I. Lebedev *In its* Perception of Space and Time in Outer Space 23 May 1968 p 8–15 (See N68-24633 14-05)

The effects that interruptions in the usual circadian rhythm will have on the psycho-physiological functions of cosmonauts are considered in terms of creating new and optimum rhythms for activities on an interplanetary spacecraft. Experimental data are reviewed to show that although the physiological processes of man under constant conditions continue to maintain the circadian rhythm for a period of time, orientation without the availability of time pieces is unreal. Although there is no definitive answer as to how long a cosmonaut will be able to carry out watch-standing duties before succuming to fatigue, the consensus is that the most optimum period should be less than four hours. M.G.J.

N68-24719*# Techtran Corp., Glen Burnie, Md.
HEREDITY AND CYTOLOGY OF SEX AS EXAMINED IN FROGS [VERERBUNG UND ZYTOLOGIE DES GESCHLECHTS NACH UNTERSUCHUNGEN AN FROSCHEN]
E. Witschi Washington NASA May 1968 33 p refs Transl. into ENGLISH from Z. Induktive Abstammungs- und Vererbungslehre, v. 28, no. 1, 1922 p 31–68
(Contract NASw-1695)
(NASA-TT-F-11685) CSCL 06C

Experimental and cytological studies of frogs are used to prove that sex determination by hereditary factors which are unevenly distributed to the gametes are only one of the possible types. Homogametic sex heredity in both sexes also exists. A concise view is presented of the present state of the problem of sex determination in frogs. Author

N68-24772*# Oregon State Univ., Corvallis.
SYSTEMATIC DESCRIPTION AND KEY TO STREPTOMYCES ISOLANTS FROM CHILE–ATACAMA DESERT, HAWAII, AND OREGON SOILS
W. B. Bollen and Sumie Nishikawa 25 Apr. 1968 79 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950783)
(NASA-CR-94759) CFSTI: HC$3.00/MF$0.65 CSCL 06M

The characteristics used to differentiate *Streptomyces* are defined as the morphology of the spore surface, the color of matured aerial mycelia, the morphology of the aerial mycelia, and the ability to produce melanin. The eight culture media used for characterizing and identifying the species are listed as tryptone–yeast extract broth, yeast extract–malt extract agar, oatmeal agar, inorganic salts–starch agar, glycerol–asparagine agar, peptone–yeast extract agar, tyrosine agar, and carbon utilization medium. The key to the identification of the *Streptomyces* isolants is listed, and descriptive charts on the laboratory cultures are presented. M.G.J.

N68-24774# Oregon State Univ., Corvallis.
RADIOTRACER STUDIES OF BIOSYNTHETIC AND RESPIRATORY PATHWAYS Final Report, Sep. 1, 1960–Oct. 31, 1967
C. H. Wang 10 Oct. 1967 12 p refs
(Contract AT(45-1)-1387)
(RLO-1387-8) CFSTI: HC$3.00/MF$0.65

Glucose: metabolism in microorganisms, rats, and tomatoes, use of concurrent pathways for; Carbon-14: yield of carbon dioxide-incorporated, from glucose metabolism; Metabolism: glucose, in mung beans and yeasts, development of radiorespirometer to determine pathways of; Eumycota: Penicillium digitatum, biosynthesis of ethylene in, effects of chloroacrylate on; Organic Acids: biosynthesis of four-carbon, in *Pseudomonas fluorescens* and tomatoes, use of glucose substrate to determine mechanism of; Hexoses: metabolism in yeasts, effects of 2-deoxyglucose on. NSA

N68-24781# Pittsburgh Univ., Pa. Dept. of Chemistry.
BIOLOGICAL APPLICATIONS OF MOESSBAUER SPECTROSCOPY Comprehensive Report, May 1965–Feb. 1968
L. M. Epstein and Darel K. Straub Feb. 1968 17 p
(Contracts AT(30-1)-3514; AT(30-1)-3859)
(NYO-3859-2) CFSTI: HC$3.00/MF$0.65

Synthetic iron complexes were studied by Moessbauer spectroscopy. Well-defined, reproducible, and readily interpretable spectra were obtainable for the octahedral complexes in which iron (3) or iron (2) is bonded to the 4 nitrogen in a porphyrin ring and further bonded in nitrogen atoms in amino molecules above and below the ring. Most of the pentacoordinate complexes displayed severe relaxation effects. For dithiocarbomate complexes, the influence of the ligand at the apex of the square pyramidal structure was demonstrated. The tris dithiocarbomate compounds displayed a surprisingly wide range of magnetic susceptibilities and their quadrupole splitting was quite sensitive to structural variations remote from the coordinating atoms. NSA

N68-24788# Joint Publications Research Service, Washington, D. C.

NEW PATTERN RECOGNITION TECHNIQUE

K. Bogdanov 16 May 1968 9 p Transl. into ENGLISH from the book "VDNKH Informatsionyy Byulleten" USSR, no. 3, 1948 p 33–35

(JPRS-45405) CFSTI: HC $3.00/MF $0.65

A technique for the mathematical description and recognition of morphological structures is based on their statistical characteristics and the analysis of the signal obtained when scanning the investigated pattern at the output of an optical density sensor. In effect, the mathematical apparatus of random process theory is used for the analysis, and the integral or differential law of distribution of the random process amplitudes are determined. A correlation analysis is then performed and the periodic components of the complex structure are discovered by using harmonic analysis. The described method may be used to analyze biological structures as well as the structures of metals, rocks, and porous and other materials. Its prospective usefulness in decoding aerial photographs and for the evaluation of complex patterns is noted. M.W.R.

N68-24859# Advisory Group for Aerospace Research and Development, Paris (France).

BEHAVIOURAL PROBLEMS IN AEROSPACE MEDICINE

Oct. 1967 430 p refs In FRENCH and ENGLISH Papers presented at the 24th Meeting of the AGARD Aerospace Medical Panel, Rhode-Saint-Genese, Belgium, 25–27 Oct. 1967

(AGARD-CP-25) CFSTI: HC $3.00/MF $0.65

Conference papers are presented on behavioral problems emphasizing diurnal rhythms, sleep, and alertness, and also on medical problems relating to space and air warfare. For individual titles, see N68-24860 to N68-24889.

N68-24860# Max-Planck-Institut fur Verhaltensphysiologie, Seewiesen uber Starnberg (West Germany).

DESYNCHRONIZATION AND RESYNCHRONIZATION OF HUMAN CIRCADIAN RHYTHMS

Juergen Aschoff *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 13 p refs (See N68-24859 14-04)

Circadian rhythms of activity, body temperature, and urine excretion have been measured in human subjects kept in isolation in an underground bunker, either in constant conditions or exposed to artificial light–dark cycles. In constant conditions, free-running rhythms synchronous in all functions have been demonstrated as well as cases with internal desynchronization. Entrainment to a 26.7-hour day resulted in changes of phase-angle differences as to be predicted from oscillation theory, whereas exposure to a 22.7-hour resulted in relative coordination between the circadian rhythms and the light–dark cycle only. A group of four subjects, enclosed together into the bunker, showed synchronous circadian rhythms during the first 10 days, thereafter desynchronization between one subject and the rest of the group. Shifts of the artificial light–dark cycle by 6 hours, simulating 'flights' in either eastward or westward direction, were followed by the activity-cycles of the subjects rather immediately; the rhythms of body temperature, however, did not regain their normal phases until several days (up to 10) had elapsed. Author

N68-24861# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.

CIRCADIAN RHYTHMS AND MILITARY MAN

Clyde H. Kratochvil *In* AGARD Behavioral Probl. in Aerospace Med. Oct. 1967 10 p refs (See N68-24859 14-04)

Reviewed are aspects of the problem of circadian rhythm and military man in which an attempt is made to answer questions concerning performance decrement related to the reversal of day–night cycles of combat troops traveling through multiple time zones via high speed transport aircraft. Questions considered are: What kind of performance will be expected while the adjustment to the new time schedule is proceeding? (2) Will there by any increase or decrease in susceptibility to various stressors? (3) How long does it take to adjust? (4) Can anything be done to speed up this process? Discussed are investigations directed toward problems of fatigue, sleep deprivation, and change of work shifts. Studies are cited which indicate that: (1) there is a change in both efficiency and susceptibility to stress as a function of time of day; (2) during adjustment to new time zones, circadian temperature rhythm may quickly adjust to new time; however, renal excretion patterns may lag behind; (3) there is a direct interrelationship between EEG activity, dreams, and variations in plasma steroids; and (4) our understanding of therapeutic drugs does not afford us the tools for inducing normal, physiological sleep. Given the existence of these phenomena and the very real possibility that these factors are of marked operational importance, the following solutions are proposed: (1) either travel to the new time zone well in advance of having to perform at peak efficiency; or (2) preadapt to the home station. S.C.W.

N68-24862# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.

THE USE OF PERIOD ANALYSIS TO EVALUATE HUMAN PHYSIOLOGICAL AND PSYCHOMOTOR PERFORMANCE

Michael Mc Cally *In* AGARD Behavioral Probl. in Aerospace Med. Oct. 1967 15 p refs (See N68-24859 14-04)

Time series analysis methods for the assessment of physiologic infradian and ultradian rhythms are reviewed, and preliminary results of recent studies employing a least squares spectrum method are presented. Focused on is the applicability of the least squares spectrum technique which provides a simple and reliable approach to (1) defining significant periods in time series, particularly in data collected at unequal intervals or with gaps; and (2) qualifying each period as to its amplitude and phase in an objective and reproducible fashion. Examples of 3, 7, and 30 day rhythms in urine volume and a spectrum of ultradian rhythms in heart rate, pulmonary ventilation and oxygen consumption are included. Data are presented not as definitive experiments to demonstrate effects of environmental change but rather as a demonstration of a new tool and a new point of view for the environmental physiologist; and to suggest new directions for research. Suggested directions for new research include: (1) detailed mapping of the spectrum of a variety of physiological and performance variables over a wide band, perhaps from one second to one month, at rest and during various levels of environmental stress; (2) the development of meaningful statistical procedures for defining confidence limits for changes in period, amplitude and phase of the observed oscillations; and (3) the definition of the specific physiologic control systems of which the observed oscillations are an expression. S.C.W.

N68-24863# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Bad Godesberg (West Germany). Institut fuer Flugmedizin.

PERIODIC VARIATIONS IN INDICES OF HUMAN PERFORMANCE, PHYSICAL FITNESS, AND STRESS RESISTANCE

K. E. Klein, H. M. Wegmann, and H. Bruener *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 21 p refs (See N68-24859 14-04)

In order to estimate the existence and magnitude of rhythmic day–night variations in human performance, physical fitness and stress resistance, the following variables were measured every three hours over a full day–night cycle: the reaction time and its individual constancy, the maximal psychomotor coordination ability, the Schneider index, the predicted VO_2max, the cardiovascular responses to tilting, and the time of useful consciousness in simulated altitude. All parameters revealed relative rhythmic oscillations of the circadian type, the ranges of which varied for the group average

between 1.4% (temperature) and 68% (17-OH-CS) of the total 24 hour average. Negative extreme values showed up during the night hours for all cardiovascular parameters; consequently the Schneider index and the VO_2 max predicted from the heart rate level during submaximal exercise had their positive peaks or best values at this time of the day. While this phenomenon seems to be an artificial effect of the way to figure out physical fitness and probably is not identical with course of fitness itself, true positive night peaks were found for the altitude tolerance. The significance of the results for the applicability of functional tests and human efficiency during load is discussed. Author

N68-24864# Royal Air Force, Farnborough (England). Flight Skills Lab.

PILOT RESPONSE UNDER GROUND SIMULATION CONDITIONS AND IN FLIGHT

A. M. Hammerton Fraser, J. M. Rolfe, and E. M. B. Smith *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 20 p refs (See N68-24859 14-04)

The physiological responses of a group of pilots were recorded while at rest and while undertaking a given flight plan under one of three situations, namely: (1) In a fixed-base simulator; (2) In a moving base simulator; and (3) In flight. Experimental objectives were to determine the rank order of the subjects in terms of the magnitude of their physiological responses when resting, and the effect of task performance in this order. Results indicated that there was consistency in rank order between subjects, but the degree of consistency varied with the physiological measure employed. Results also indicated differences in the magnitude of physiological response between resting and performing. The size of the differences was also shown to be dependent upon the situation in which the task was performed and the type of manoeuver being undertaken. A method of combining a subject's different physiological responses is demonstrated and conclusions are drawn as to the value of the results in assessing simulator fidelity. Author

N68-24865# Naval Air Development Center, Johnsville, Pa. Aerospace Medical Research Dept.

METHODS USED AT AMRD IN THE STUDY OF NORMAL SLEEP AND DRUG-INDUCED SLEEP ON A VISUAL ALERTNESS TEST

R. D. Squires and W. C. Sipple *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 8 p refs (See N68-24859 14-04)

Methods used in an ongoing study of human sleep are briefly described. The ultimate aim of this study is to induce normal, restful sleep by pharmacological means with minimal undesired side effects. The methods used are designed to test the restorative effect of sleep and its relationship to time spent in the various stages or levels of sleep to the restorative effect. Author

N68-24866# Naval Air Development Center, Johnsville, Pa. Aerospace Medical Research Dept.

THE EFFECTS OF NORMAL SLEEP AND DRUG-INDUCED SLEEP ON A VISUAL ALERTNESS TEST

R. J. Oleynik and R. D. Squires *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 9 p (See N68-24859 14-04)

In view of the need for increased pharmacological knowledge and practice to maximize capabilities of pilots in sustained aerospace missions, a study was undertaken to evaluate various hypnotic sedatives with respect to quality of sleep elicited, arousal characteristics, and psychophysiological performance. Focused on is the relative importance of the two distinct phases of sleep, the rapid eye movement phase (REM) and the nonrapid eye movement phase (REM), in obtaining restful sleep. Human male subjects were exposed to ingestion of various hypnotic-sedative drugs in moderate dosage, after which they were asked to sleep. Drugs used included Chlordiazepoxide, Meprobamate, Methaqualone, Hydroxyzine, and Pentobarbital. The expected result was to select a hypnotic-sedative drug suitable for long term aerospace or other military missions which would fulfill the following desirable criteria: (1) elicit restful sleep, presumably by keeping the normal REM/NREM ratio intact, (2) permit ease of arousal at any time after drug ingestion, and (3) cause no minimal impairment of performance at any time after taking the drug. Results indicated that Pentobarbital decreased REM time markedly over control-placebo levels; however, the other preparations had minimal or equivocal effects. The initiation of experiments using sodium gamma-hydroxybutyrate, a drug which produces a state of environmental detachment much like REM sleep, in addition to having characteristics of rapid recovery and low toxicity, is reported S.C.W.

N68-24867# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.

NOREPINEPARINE AND SEROTONIN EFFECTS ON SLEEP, ALERTNESS, AND TEMPERATURE REGULATION

Thomas J. Crowley *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 19 p refs (See N68-24859 14-04)

Research designed to determine the joint pharmacology of sleep and temperature is reported. Emphasized is the possible role of norepinephrine and serotonin in sleep and temperature regulation. Two rhesus monkeys were studied to determine the effects of norepinephrine injections. Results suggested that cerebral norepinephrine decreases REM sleep and temperature in primates, and also that norepinephrine may contribute to wakefulness. A pilot study of the effects of alpha-methyl-paratyrosine (AMPT) was made upon monkeys to determine whether a sedative effect results from the depletion of norepinephrine or of serotonin. Results did not yield enough information to make definite conclusions about AMPT's effect on EEG and temperature; however, the subjects showed dramatic and rather bizarre lethargy and sedation when treated with the norepinephrine depleter, AMPT. The initiation of studies involving the injection of the third ventricle of sleeping monkeys with serotonin is reported. Although results are not finalized, it appears that serotonin changes monkey brain temperature in the same direction as norepinephrine; and initial injections partially suppressed REM sleep. It is suggested on the basis of these findings, there is a possible role for norepinephrine and serotonin in the diurnal regulation of sleep and temperature. S.C.W.

N68-24868# Army Aeromedical Research Unit, Fort Rucker, Ala.

ELECTROCARDIOGRAPHIC SURVEY OF ROUTINE DUTY DAYS IN HELICOPTER PILOTS

W. P. Schane *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 8 p (See N68-24859 14-04)

A qualitative evaluation of the interaction between man, flying systems, and environment is presented which was designed to (1) determine the responses of the cardiovascular system to flying, and (2) to establish realistic selection and retention standards for U.S. Army helicopter pilots. EKG records of fifty-three helicopter instructor pilots actively engaged in student training were studied to determine the lowest and highest heart rates recorded which were sustained for at least one minute, and the specific activity of each subject during this period. The only significant correlations derived from these studies indicated that persons with high heart rates during any one type activity tended to have high heart rates during all tested activities, and vice versa. Since on the basis of these studies it appears that helicopter flying is no more stressful to the heart than automobile driving, the question is raised as to whether severely restrictive physical standards of cardiac performance are necessary. It is concluded further that although initial examination is essential to exclude applicants with chronic cardiovascular pathology, and yearly examination is advisable to detect change since the last examination, it appears unreasonable to exclude a trained helicopter pilot from flying for trivial and questionable cardiac aberrations. S.C.W.

N68-24869# Army Aeromedical Research Unit, Fort Rucker, Ala.
THE MORBIDITY OF ARMY AVIATORS, A PRELIMINARY STUDY
R. Bailey *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 7 p ref (See N68-24859 14-04)

Reported is the initiation of a statistical study designed to provide answers to questions such as: (1) Does the Flight Surgeon see different, or unique types of clinical problems among the Army aviation population (non-combat personnel) than the standard population? (2) Does the special training for aviation medical officers and flight surgeons need to be modified to provide the therapy required by the population they are expected to treat? (3) Does this special population present itself for therapy and treatment of medical problems for which sufficient consideration has not been made prior to or during aviation medicine training? Partial results of 9,483 sick call visits over a period of 22 months beginning in June 1964 are given, and compared with a 1943 Navy study. S.C.W.

N68-24870# Advisory Group for Aerospace Research and Development, Paris (France).
STUDY OF THE VIGILANCE AND THE PSYCHOMOTOR REACTIONS ON PRIMATES PLACED IN BALLISTIC FLIGHT [ETUDE DE LA VIGILANCE ET DES REACTIONS PSYCHOMOTRICES SUR DES PRIMATES PLACES EN VOL BALISTIQUE]
G. Chatelier and Belugou *In its* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 11 p In FRENCH (See N68-24859 14-04)

It is hypothesized that a gravimetric sensation participates in maintaining cortical alertness; and in this case, weightlessness hazards lead to the lowering of alertness level. Two monkeys, conditioned to carry out a simple psychomotor gesture, were equipped with electrodes to register electrocorticographic, myographic, and vegetative responses during flight. A polygraph transmitted by telemetry permitted the collection of these data. One monkey, in a state of pure weightlessness, exhibited a complete absence of conditioned reflexes and considerable lowering of alertness. The other monkey rested quietly before the flight and exhibited normal psychomotor responses. Transl. by M.W.R.

N68-24874# Naval Submarine Medical Center, Groton, Conn. Submarine Medical Research Lab.
AREAS OF COINCIDENCE IN AEROSPACE AND SUBMARINE MEDICAL RESEARCH
Charles F. Gell *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 9 p (See N68-24859 14-04)

The following discussion identifies the bio-medical problems existing in aerospace and submarine diving activities that have similarity in their physical aspects and the psychophysiological response of man thereto. These problems are identified in three, time/altitude and time/ocean depth relationships. The physical stressors in both aerospace and ocean environments are related to: lack of breathing oxygen, toxic gases, bends, cold, explosive decompression, atmospheric ionization, circadian rhythm alterations, disorientation, vertigo and respiratory response to rare gases. Psychological problems of similarity are stated as human factors engineering, selection of personnel, reaction to confinement, isolation, training and simulation methods. Author

N68-24875# Centre d'Enseignement et de Recherches de Medecine Aeronautique, Paris (France).
STUDY OF BIOLOGICAL ACTION OF COSMIC RAYS BY MEANS OF SOUNDING BALLOONS [ETUDE DE L'ACTION BIOLOGIQUE DES RAYONS COSMIQUES—AU MOYEN DE BALLONS SONDES]
A. Pfister, G. Deltour, H. Atlan, R. Kaiser, and L. Miro *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 10 p In FRENCH Prepared in cooperation with Centre de Rech. Nucl., Strasbourg (See N68-24859 14-04)

Biological effects due to the heavy ions in primary cosmic rays were studied over a three year period with the aid of sounding balloons at 30,000 meters. Experiments of two types, both using recoverable containers, were performed. Black mice were used in one group of studies to determine anatomical-pathological lesions to the skin by the passage or disintegration of heavy ions as well as the modifications in protein anabolism. Autoradiographic methods were used for these determinations. For the other studies bacteriological preparations were used to find evidence of mutagenic effects, and relative biological effectiveness coefficients for the heavy ions were determined. Sensitivity of such tests are dependent upon the use of concentrated cultures and better references of the particle traces in the cultures. Transl. by M.W.R.

N68-24876# Air Force Systems Command, Brooks AFB, Tex.
THE RADIOBIOLOGICAL HIATUS IN SPACE
E. R. Ballinger *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 7 p (See N68-24859 14-04)

Problems concerned with the incidence of radiation induced lethality from space energy protons or electrons are discussed. On the basis of animal studies and clinical radiotherapeutic studies of humans the following generalities are made: (1) the incidence of radiation induced lethality in space will be remote as compared with the incidence of tissue damage to the skin, eyes, and other superficially located organs; (2) following a single sizable exposure, a second mission should not be undertaken with the assumption of a recovery expressed commonly as for instance 10 to 20% per day of the recoverable fraction; (3) as mission durations increase, life support equipment will also increase, making a contribution to shielding; and as flights become heavily shielded the radiation of concern will become predominantly gamma, bremsstrahlung, and neutrons rather than protons and electrons; (4) for prolonged flights where possible a rigorous adherence to exposure criteria will be carried out during the early stages; and (5) the more serious problems may be psychological due to prolonged isolation and confinement on, for instance, a three year flight to a distant planet. S.C.W.

N68-24877# Air Force Systems Command, Los Angeles, Calif. Aerospace Medical Div.
SLEEP REQUIREMENTS DURING MANNED SPACE FLIGHT
Louis F. Johnson, Jr. *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 4 p refs (See N68-24859 14-04)

Sleep requirements for astronauts during manned space flight are discussed in an attempt to answer the following questions: (1) How much sleep is necessary? (2) What quality or depth of sleep is necessary? (3) What periodicity of the wakefulness/sleep cycle is satisfactory for good performance? It is concluded that astronauts on prolonged space flights should have eight hours of continuous sleep at their normal depth of sleep out of each twenty-four hours if possible; and if the preceeding is not possible, a different wakefulness/rest ratio must be used, for example, twelve hours work/six hours rest plus another two hour rest period in each twenty-four hour period. S.C.W.

N68-24883# Belgian Air Force, Brussels. Centre de Medecine Aeronautique.
STUDY OF THE NORMAL VALUES OF THE VITAL CAPACITY AND MAXIMUM/SECOND EXPIRING VOLUME IN THE NAVIGATORS IN THE BELGIAN AIR FORCE [ETUDE DES VALEURS NORMALES DE LA CAPACITE VITALE ET DU VOLUME EXPIRATOIRE MAXIMUM/SECONDE CHEZ LE PERSONNEL NAVIGANT DE LA FORCE AERIENNE BELGE]

J. Bande *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 30 p refs In FRENCH (See N68-24859 14-04)

Following a brief description of the technique used to determine vital capacity and "maximum second" expiration volume, the sensitive factors that influence the measurements were analyzed. A population of normal subjects was used to determine the measurements as a function of size and age; and a longitudinal study covered data obtained over a five-year period. Results were compared with theoretical expectations, and the influence of habitual smoking on respiration parameters was studied. Transl. by M.W.R.

N68-24884# Louvain Univ. (Belgium).
MATHEMATICAL ANALYSIS OF THE OUTLINE OF THE FORCES EXPIRATION TEST [ANALYSE MATHEMATIQUE DU TRACE DE L'EPREUVE D'EXPIRATION FORCEE]
J. Clement (Belg. AF, Brussels) and K. Van De Woestyne *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 9 p ref In FRENCH (See N68-24859 14-04)

Three formulas were applied to tracings of forced expiration determined by spirometry and pneumotachography, and analyses were made by a nonlinear regression method on 15 points of the selected curve and at intervals of 2 seconds from the moment of the maximum output. This procedure permitted verification of the validity of the formulas and the reproducibility of the volumes. The method used did not always permit a real solution of the roots of the equation for forced experiation, notably when subjects had bronchial obstructions. Two of the equations were not of value with other subjects for periods between 0.4 to 3 seconds, and the third equation had its limitations. Reproducibility of theoretical volumes at 1 second is comparable to the maximum second expiration volumes, and reproducibility of the general form of the curve as a function of volume is excellent. Transl. by M.W.R.

N68-24886# Aerospace Medicine Center, Rome (Italy).
BEHAVIOUR OF PULMONARY VENTILATION AND ALVEOLAR GASES TENSIONS IN ATHLETES, BEFORE, DURING, AND AFTER A FIVE WEEKS STAY AT THE ALTITUDE OF 2250 M
A. Scano and G. Meineri *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 13 p refs (See N68-24859 14-04)

Respiratory functions of Italian athletes were studied both at rest and during strenuous exercise to determine the feasibility of improving their performance by submitting them to a few weeks of adaptation at altitude. Reported are results of research on the characteristics of pulmonary ventilation and oxygen and carbon dioxide alveolar tensions, recorded under control conditions, and at intervals during adaptation to Mexico City altitudes. Respiratory parameters, i.e., pulmonary ventilation and alveolar respiratory gaseous tension at rest, were studied at sea level, and at simulated altitudes of 2300 and 5500. Results indicated that pulmonary ventilation under experimental conditions was constantly and significantly increased. Values recorded at Mexico City failed to indicate significant differences during successive six day intervals. The relationship of these studies with similar studies of man's adaptation and acclimatization to altitude, and effects of hypoxia, is discussed. S.C.W.

N68-24887# Naval Medical Research Inst., Bethesda, Md.
A THERMAL MODEL FOR RETINAL DAMAGE INDUCED BY PULSED LASERS
Jude R. Hayes and Myron L. Wolbarsht *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 21 p refs Sponsored in part by DASA (See N68-24859 14-04)

The model of the retina employing the thermal absorption of a slab of the pigment epithelium layer (assumed to be homogeneous) as proposed by Vos has been examined for both long exposure times (for which it was designed) and short exposure times. The model is sufficient to explain the damage from long exposures but not short exposures. The physical characteristics of the pigment epithelium was examined, particularly with respect to the thermal stability and optical properties of the melanin granules. A new model is proposed which is based on absorption of the incident energy by the one micron diameter pigment granules and thermal conduction from them to nearby essential retinal structures such as the pigment cell membrane and the receptor cell myeloid body and outer segment. This model explains both long and short pulse damage. Such nonlinear effects as ionization from intense electric field gradients, harmonic generation, Brillouin scattering, shock waves, and re-radiation by blackbody emission are shown to make negligible contribution to the initial tissue damage where the lesion is minimal. Shorter event times (10^{-12} seconds) which are possible from mode locked laser operation may require other mechanisms than postulated by this theory. Author

N68-24888*# Naval Medical Research Inst., Bethesda, Md.
MECHANISMS OF INJURY FROM VIBRATION
D. J. Sass, Jude R. Hayes, and D. E. Goldman *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 12 p refs (See N68-24859 14-04)
(NASA Order R-10) CSCL 06C

Studies were carried out on anesthetized cats immersed in a transparent water-filled tank and vibrated erect along the longitudinal body axis. Gross examinations were performed on all animals immediately after vibration. Autopsy findings showed similarities to blast injury. Mediastinal emphysema and air embolism were found in cats vibrated erect at relatively low levels of acceleration. At higher levels, mediastinal air dissected downward to inflate the peritoneal cavity and retroperitoneal spaces. The presence of intra-abdominal air was associated with rupture of the liver and tearing of both the portal vein and the inferior vena cava. Previous investigations in our laboratory on cats vibrated in the supine position in a water immersion tank had shown lung contusion to be the predominant injury. This was attributed to the heart pounding the lungs against the chest wall. Results of the present study when compared with this earlier work, indicate that body position is a critical factor in the mechanism of vibration injury. Author

N68-24889# Institute of Aviation Medicine, Fuerstenfeldbruck (West Germany).
BALLISTOCARDIOGRAPHIC DETERMINATION OF STROKE VOLUME AND CARDIAC PERFORMANCE
H. W. Kirchhoff *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 16 p (See N68-24859 14-04)

Principles and applications of ballistocardiographic techniques used in the determination of stroke volume and human heart performance are discussed. S.C.W.

N68-24915*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
DISPERSION AND ATTENUATION OF SMALL ARTIFICIAL PRESSURE WAVES IN THE AORTA
Max Anliker, Michael B. Histand, and Eric Ogden (NASA. Ames Res. Center) Apr. 1968 9 p refs
(Grant NGR-05-020-223)
(NASA-CR-94696; SU-DAAR-342) CFSTI: HC $3.00/MF $0.65 CSCL 06P

The elastic behavior of large blood vessels was determined in terms of their transmission characteristics for small sinusoidal pressure signals. The method utilizes transient signals of the form of finite trains of sine waves superimposed on the naturally occurring pressure fluctuations. Its application to the thoracic aortae of 18 mature mongrel dogs anesthetized with Nembutal shows that dispersion and attenuation data for frequencies between 40 and

200 cps can be obtained without requiring either Fourier transform computations or resolution of reflection interference. The aorta is only mildly dispersive but exhibits strong attenuation that must be attributed primarily to dissipative mechanisms in the vessel wall. At normal blood pressure levels the wave speed during diastole can have a value between 4 and 6 m/sec. The amplitude ratio of the waves exhibits the same exponential decay pattern with distance measured in wavelengths. A marked increase in wave speed is observed from diastole to systole, associated with an increase in mean flow and with a stiffening of the aortic wall due to the rise in pressure. This phenomenon implies that the aortae should exhibit nonlinear properties with respect to large amplitude pulse waves such as those generated by the heart. Author

N68-24925*# Oregon State Univ., Corvallis.
SYSTEMATIC DESCRIPTION AND KEY TO ISOLANTS FROM ATACAMA DESERT, CHILE
W. B. Bollen, Fred Au, and Karen M. Byers 7 May 1968 40 p Prepared for JPL
(Contracts NAS7-100; JPL-950783)
(NASA-CR-94758) CFSTI: HC $3.00/MF $0.65 CSCL 06M

The following report identifies 32 isolants from soils of the Chile Atacama Desert. Of the 32 isolants there are 5 molds, 1 yeast, 8 actinomycetes and 18 bacteria representing 15.6%, 3.1%, 25.0% and 56.3% respectively. In this report the yeast and mold isolants are disregarded. The actinomycetes are being studied for identification. The remaining bacterial cultures are identified and presented in this report. A dichotomous key and a list of the isolants and species designations precedes the descriptive charts for each isolant. In addition to the descriptive charts for the viable isolants, photomicrographs of the non-viable isolants are included. Of the 18 bacterial isolants 2 are *Micrococcus* ssp., 4 are *Mycococcus* spp.[2], 2 are "soil diphtheroids" and 10 are *Bacillus* spp., comprising 11.1%, 22.2%, 11.1% and 55.6% respectively. Author

N68-24968# National Academy of Sciences–National Research Council, Washington, D. C.
LASER EYE EFFECTS
Harry G. Sperling, ed. Apr. 1968 94 p refs
(Contract Nonr-2300(05))
(AD-667494)

Contents: A review of technical characteristics of lasers; Retinal injury from laser and light exposure; Laser functional effect; Personnel protection from lasers and a discussion of eye protective devices; Devices for eye protection; Eye examination standards and treatment. TAB

N68-24999*# IIT Research Inst., Chicago, Ill.
LIFE IN EXTRATERRESTRIAL ENVIRONMENTS Quarterly Status Report, 29 Feb.–15 May 1968
15 May 1968 12 p
(Contract NASr-22; IITRI Proj. L6023)
(NASA-CR-94790; IITRI-L6023-13) CFSTI: HC $3.00/MF $0.65 CSCL 06C

In examining the effects of incubation temperatures and salt concentrations on the growth response of *Staphylococcus aureus* in a simulated Martian environment, it was found that the *S. aureus* grew with constant 35°C and daily freeze–thaw incubation temperatures. However when 2% sodium chloride was added to the soil, growth did not occur at any incubation temperature. Available moisture (a_w) is considered to be the major factor controlling growth; barometric pressure and temperature become increasingly important as the a_w of the environment approaches the limiting value for growth of an organism. Preliminary experiments on the abrasive effect of soil particles on bacteria survival indicate that a positive effect is exerted initially, and that the viable cell population decreases during the first 24 hours with no further reduction. Isolation of salt tolerant bacteria from soil is reported. M.G.J.

N68-25007 Michigan State Univ., East Lansing.
HEAT STRESS AND STRAIN IN MEN WEARING IMPERMEABLE CLOTHING
Adolph Richard Dasler (Ph.D. Thesis) 1966 135 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-1615

The purpose of this study was to realistically determine the physiological tolerance of man to heat stress while wearing unventilated, impermeable, full body clothing that barred evaporative heat loss. The ambient environmental temperatures ranged from DB 18.3°C and WB 12.2°C (65 and 54°F) to DB 32.2°C and WB 26.6°C (90 and 80°F). Air velocity over the surface of the suit was controlled <50, 250 and 1000 feet per minute. The variable of physical activity was limited to standing at rest, work by stepping up two 6" steps and then stepping back down at a regulated rate of 10 round trips per minute, or a combination of rest and work. A total of 10 combinations of the above variables were investigated. Dissert. Abstr.

N68-25095*# University of Southern Calif., Los Angeles. Dept. of Physiology.
INVESTIGATION TO DETERMINE THE EFFECTS OF LONG TERM BED REST ON G-TOLERANCE AND ON PSYCHOMOTOR PERFORMANCE Final Report
John P. Meehan, James P. Henry, Shannon Brunjes, and Herbert de Vries 19 Sep. 1966 54 p refs
(Contract NAS9-3500)
(NASA-CR-62073) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Fourteen young men were confined to bed for 28 days. They were randomly divided into three subject groups of 5, 5 and 4 individuals. One group exercised, another did pressure breathing and the third did both. Each subject was exposed to a re-entry acceleration profile in the −Gx position while performing a three dimensional tracking task prior to the bed rest and at the conclusion of the bed rest. Tilt table tolerance and blood volumes were determined in a similar sequence. Cardiovascular deconditioning manifested by plasma volume decrements of 20% and decreased tolerance to passive tilting resulted in all subjects and was not differentially affected by the exercise, pressure breathing or the combination maneuvers. Performance on the tracking task during acceleration was not affected by the cardiovascular deconditioning. Author

N68-25119# Cekmece Nuclear Research Center, Istanbul (Turkey).
MEASURING THE DURATION OF VERY LOW FREQUENCIES, PARTICULARLY THE INSTANTANEOUS HUMAN RESPIRATION FREQUENCIES [DAUERMESSUNG SEHR NIEDRIGER FREQUENZEN, INSBESONDERE DER MOMENTANEN MENSCHLICHEN ATMUNGSFREQUENZ]
Umur Buektas and Engin Ekonomi Feb. 1968 37 p refs In GERMAN; ENGLISH summary
(CNAEM-50) CFSTI: HC $3.00/MF $0.65

During clinical and biophysical examinations in which fast changes of the respiration rate are of interest, the instantaneous respiration frequency must be recorded instead of the average value. The authors report of two electronic devices by means of which the instantaneous frequency of successive pulses can be continuously recorded in the range of 1 Hz to 0.02 Hz. The first device incorporates an analog and the second one a digital display of the measured values. Both have an accuracy of ±0.002 Hz. The digital version can be connected to a computer through an interface. Author

N68-25143*# Massachusetts Inst. of Tech., Cambridge. Man-Vehicle Control Lab.

BIOPHYSICAL EVALUATION OF THE HUMAN VESTIBULAR SYSTEM Semiannual Status Report

J. L. Meiry and L. R. Young Jan. 1968 14 p refs

(Grant NGR-22-009-156)

(NASA-CR-94779; MV-68-1; SASR-4) CFSTI: HC $3.00/MF $0.65 CSCL 06P

This research was conducted to evaluate the dynamic characteristics of the human semicircular canals by a detailed examination of their physical properties and to correlate them with physiological and behavioral data. Properties of viscosity, thermal coefficient of viscosity, density, and thermal coefficient of expansion were measured for endolymph and perilymph and were used to evaluate the coefficients of the equations of the dynamic response of the semicircular canals. The influences of the inertia and viscous drag of the cupula and of the flexible membranous canalicular duct have resulted in a new dynamic model for the response of the semicircular canals to angular and linear acceleration. Canalicular response to thermal stimulation was found to produce the physiological equivalent of an angular acceleration. R.N.A.

N68-25178# Naval Medical School, Bethesda, Md.

ELECTRON STIMULATION OF BIOPOLYMERS

S. V. Konev Feb. 1968 251 p Transl. into ENGLISH of the publ. "Elektronno-Vozbushdennye Gostoianiia Biopolimerov" Minsk, Nauka i Tekhnika, 1965 p 1–186 *Its* Transl. No. 1236

(AD-667499)

The report represents the first attempt to compile and organize works relative to the discovery and studies of the nature of electron-stimulated states of the two principal classes of biopolymers: proteins and nucleic acids. Particular attention is given to the biological role of the electron-stimulated states, the mechanism of their appearance, migration and prolonged concentration of energy. Problems are reviewed in reciprocal spectral luminescence characteristics of biopolymers with their secondary, tertiary and quaternary structures, potential application of photoluminescence of the biopolymers, as a source of information on the physico-chemical and structural organization of the vital cells on the molecular and supramolecular levels. Author (TAB)

N68-25249 Ohio State Univ., Columbus.

METABOLIC CHANGES IN ANIMALS EXPOSED TO A HELIUM-OXYGEN ENVIRONMENT

Rodney Allen Rhoades (Ph.D. Thesis) 1966 141 p

Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-2523

Chicks, mice, and rats were exposed acutely (one to three hours) and chronically (ten days) to a 79 percent helium and 21 percent oxygen mixture. In the chronic exposures animals were maintained in a sealed polyvinyl isolator in which oxygen was kept at 20 to 22 percent, carbon dioxide below 0.5 percent, nitrogen under 2 percent, ambient temperature between 25 degrees and 30 degrees centigrade, and relative humidity between 50 and 70 percent. The controls were kept in an identical isolator filled with air. Rectal temperature, subcutaneous temperature, tail temperature, heart rate, and respiration rate were measured simultaneously with oxygen consumption on 54 acutely and 18 chronically exposed rats at different ambient temperatures (23 degrees, 28 degrees, 33 degrees, centrigrade). Each rat, whether acute or chronic, was tested both in helium and oxygen and air. It was concluded that the physiological effects of helium in the intact homeotherms were a function of its six and one-half fold higher heat conductivity by comparison with nitrogen. In addition to previous observations, a 10 percent depression in metabolism was found upon the transfer of rats from helium and oxygen to air. Dissert. Abstr.

N68-25263# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

INDUCED RADIONUCLIDES IN ASTRONAUTS Quarterly Activity Report, 1 Jul.–1 Oct. 1967

R. W. Perkins 8 Oct. 1967 21 p refs

(Contract AT(45-1)-1830)

(BNWL-531-1) CFSTI: HC $3.00/MF $0.65

An estimate of radionuclides that would be produced in an astronaut during a two-day orbital flight is tabulated. The calculations were based on spallation or capture reactions for protons with energies from 100 to 600 MeV. A list is presented of methods of production by cosmic radiation of radioisotopes of Ar, Be, Cl, Cu, K, Mg, Mn, Na, Rb, S, and Si. Tissue equivalent solutions that contained O, C, H, N, Ca, P, S, K, Na, Cl, Mg, Fe, Rb, Cu, and Mn at the concentrations present in a standard man were prepared by using chelating agents. The tissue equivalent solutions were bombarded with 14 MeV neutrons, 4 MeV neutrons, thermal neutrons, and natural cosmic radiation at 60,000 to 63,000 ft and provided a qualitative picture of the radiosotopes produced by the various neutron capture and spallation reactions. The data are tabulated. NSA

N68-25340*# Naval Medical Research Inst., Bethesda, Md.

EFFECT OF PARABAROSIS (ALTERED BAROMETRIC PRESSURE AND ATMOSPHERIC COMPOSITION) ON SUSCEPTIBILITY TO INFECTION

[1967] 6 p Round Tables Notes Presented at Colonnade South, Hotel Taft, 2 May 1967

(NASA Order L-97464; NASA Order R-21-010-010)

(NASA-CR-84683) CFSTI: HC $3.00/MF $0.65 CSCL 06M

The term parabarosis is used to signify any natural or artificial alteration, beyond physiologically normal limits, in the gaseous environment, with respect to content and/or pressure. Abstracts are presented on various experimental studies concerned primarily with effects of parabarosis on infection. Various types of parabaric conditions are identified and the effects of parabarosis on microorganisms, hosts, and environment are described. B.S.D.

N68-25382*# Naval Aerospace Medical Inst., Pensacola, Fla.

PUBLIC HEALTH ASPECTS OF GALACTIC RADIATION EXPOSURE IN SUPERSONIC TRANSPORT

Hermann J. Schaefer 19 Mar. 1968 13 p refs

(NASA Order R-75)

(NASA-CR-94760; NAMI-1033) CFSTI: HC $3.00/MF $0.65 CSCL 06R

The prospect of large-scale commercial passenger transportation at SST altitudes in the lower stratosphere calls for an accurate assessment of the galactic radiation exposure. Highest radiation levels prevail at high latitudes (polar region) and solar minimum and reach about 1 millirem/hour at 65,000 feet. The accumulated dose of 0.6 rem/year which an SST crew member spending 600 hours/year at altitude would receive exceeds the Maximum Permissible Dose (MPD) for "Members of the Public" and would classify crew members as "Radiation Workers" in terms of official recommendations. The assumption of 50 SST each exposing 200 passengers to 1000 hours/year at SST altitude would lead to a population dose about equal to the contribution from industrial radiation workers, with both exposures ranking well below the two largest man-made additions to the natural background, medical use of X-rays and fallout. The heavy flux is attenuated to 3 percent or less at 65,000 feet, depending on the nuclear species; yet, only 0.1 percent of this residual flux accounts for maximum ionization hits. That means the microbeam hazard of heavy nuclei is insignificant at SST altitudes. Author

N68-25462 Florida State Univ., Tallahassee.

A STUDY OF CUTANEOUS THERMAL SENSITIVITY UNDER CONDITIONS OF INDUCED VASOMOTOR STATES IN THE SKIN

Donald Marcel Scott (Ph.D. Thesis) 1966 46 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-312

Although a specific temperature receptor has not been identified in the human skin, several theories have been proposed to account for the phenomenon of cutaneous thermal sensation. One of these, the Quantitative Theory, attributes the receptor function to the cutaneous blood vessels. To test this suggestion, vasoconstriction was induced in the skin of human subjects by ice ingestion and by iontophoresis of epinephrine, and vasodilation was obtained by exercise to raise body temperature and by methacholine iontophoresis. In addition, Musterole was applied to obtain vasodilation by rubefacient drug. Thermal thresholds were measured by the psychophysical method of limits under normal "control" and experimental conditions. Relative cutaneous vasodilation was confirmed using photoelectric plethysmographic measures of the volume pulse size under all experimental conditions. Both means of vasoconstriction produced increase in warm sensitivity at cool adapting temperatures and decrease in cool sensitivity at warm adapting temperatures. Dissert. Abstr.

N68-25623*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MORPHOLOGICAL STUDIES OF LAMINAR LESIONS
Webb Haymaker [1967] 16 p refs Presented at AEC Biomed. Advisory Comm. Meeting, Berkeley, Calif., 10–11 Mar. 1967
(NASA-TM-X-59783) CFSTI: HC $3.00/MF $0.65 CSCL 06C

Briefly reviewed are studies on dose-tissue volume factors in the pathogenesis of laminar lesions of the cerebral cortex as observed through contributions made by the various laminae to cortical electrical activity. A laminar preparation in which only the upper part of the cortex is damaged is most widely used to evaluate the edematous process of radiation injury and the observed increased glycogen content. G.G.

N68-25639*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MAN, HIS ENVIRONMENT AND MICROBIOLOGICAL PROBLEMS OF LONG-TERM SPACE FLIGHT
Judd R. Wilkins [1967] 27 p refs Presented at the Conf. on Bioastronautics, Blacksburg, Va., 14–18 Aug. 1967
(NASA-TM-X-60422) CFSTI: HC $3.00/MF $0.65 CSCL 06M

Research focusing on studies of a wide spectrum of possible environmental and microbiological problems associated with placing man in a closed environment for long periods of time, as for example, during prolonged space flight; is reported. Reviewed are studies of life support requirements; microbiological studies to determine the effect of space flight conditions on man and experimental animals; and studies focusing on the development of life support subsystems. S.C.W.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N68-24408# Royal Aircraft Establishment, Farnborough (England).
ON THE PROBLEM OF THE AFFERENTATION OF EYE MOVEMENTS. A STUDY OF EYE MOVEMENTS USING A PHOTOELECTRIC METHOD [K PROBLEME AFFERENTATSII DVIZHENII GLAZ]
E. D. Khomskaya Jan. 1968 19 p refs Transl. into ENGLISH from Vopr. Psikhologii (Moscow), v. 3, 1962 p 73–84
(RAE-LIB-TRANS-1280) CFSTI: HC $3.00/MF $0.65

An experimental study designed to determine whether a change of afferentation influences the realization of eye movements is reported. A comparison was made between eye movements controlled by a visual signal and those performed without visual control. The characteristics of these types of movement, their form, frequency characteristics, and stability were elucidated; the relationship between the form of eye movements and their frequency was investigated; and the possibility of reproducing various given parameters of movements (form and frequency) from memory were also studied. Primarily, the experimental study was devoted to a comparative analysis of eye movements performed with and without visual control. Results showed that changes in afferentation had a marked effect on eye movements. Eye movements controlled by a visual signal and those carried out without visual control showed a number of differences which related in the first instance to the form of eye movements. The second difference between eye movements controlled by a visual signal and those carried out independently by subjects without visual control was related to their frequency characteristics. It was found that there is a direct relationship between the form of pursuit eye movements and their frequency characteristics. On the basis of these findings it is concluded that there are different levels of eye movement control which are linked with different forms of afferentation, one of these being the level of pursuit movements controlled to a considerable extent by a visual stimulus; the other is the level of independent changes of fixation without visual reference but controlled by a program created by the subject. S.C.W.

N68-24408# Systems Technology, Inc., Hawthorne, Calif.
A REEXAMINATION OF EYE MOVEMENT DATA
Warren F. Clement, Dunstan Graham, and John J. Best 28 Feb. 1967 121 p refs
(Contract N00014-66-C-0072)
(TM-163-A; AD-667768)

An analysis is presented of aircraft pilot eye movement data obtained in the past by other investigators from piloted flight tests. This includes a comprehensive account and reanalysis of the data contained in several reports, by different investigators, and it suggests some features of a useful systems model which should be compatible with (i.e., explain) all, or nearly all, of these data. A review is presented of key contributions to the literature, primarily of Fitts and Senders work. Pilots eye fixation frequency measurements are first discussed with respect to four possible variables on which they may depend: display-control closed-loop bandwidth, flight maneuvers, instrument arrangement, and the redundancy of information. Pilots eye fixation dwell times are then discussed with respect to a quantized time interval which appears in certain experiments, and the purpose for and type of sampled signal reconstruction which may be performed by the pilot. An approximate method suggested by Senders for calculating paired-display fixation link values is applied to one of the extant cases not investigated by him. Some experiments are suggested to resolve questions, validate models and fill voids in existing results. Author (TAB)

N68-24515# Royal Aircraft Establishment, Farnborough (England).
THE REPRODUCTION OF A SET RHYTHM OF EYE MOVEMENTS FROM MEMORY [VOSPROIZVEDENIE ZADANNOGO RITMA DVIZHENIYA GLAZ PO PAMYATI]
E. Yu. Artem'eva and E. D. Khomskaya Feb. 1968 13 p refs Transl. into ENGLISH from Vopr. Psikhologii (Moscow), no. 6, 1965 p 110–114
(RAE-LIB-TRANS-1288) CFSTI: HC $3.00/MF $0.65

Horizontal eye movements of 30° amplitude were investigated in 11 normal subjects by means of a photo-electric technique. After 60 seconds of tracking a light spot, subjects had to reproduce the same sine-wave eye movements from memory. Target frequency ranged from 0.32 to 1.44 cycles/second. Reproduction was seen to take the form of alternation between cycles of fairly good

waveform and cycles which were clearly inadequate. Reproduction accuracy depended on target frequency, and showed large differences between individual subjects. The ability was, to a point, amenable to training. The introduction of a sound cue permitted better timing of the reproduced eye movements. Author

N68-24521# Rockford Research Inst., Inc., Cambridge, Mass.
INDUCTIVE INFERENCE RESEARCH: STATUS, SPRING 1967 Final Report, May 1966–Jul. 1967
Raymond J. Solomonoff 1 Jul. 1967 30 p refs
(Contract AF-19(628)-5975)
(RTB-154; AFCRL-67-0462; AD-667810)

Previously, four theories of inductive inference were proposed, and present work is concerned with putting these theories on a firmer theoretical footing. The four theories are now found to be effectively equivalent, at varying levels of rigor. It is shown that for sufficiently long sequences of symbols the theories actually do give the correct probabilities for future symbols. Attempts are made to implement induction theories through a general approach to networks of tasks. Applications of induction theory to man-to-animal communication are considered, and some new approaches to interspecies communication are suggested. It is now shown that the induction theories developed for discrete symbols can be applied to prediction of continuous data. Computer implementation of induction through use of definitions of subsequences of symbols may prove to be a valuable line of effort. Supervisory problems in dealing with very intelligent machines are discussed, parallels are shown to the problem of dealing with ambitious subordinates, and a remedy for the case of the machines is proposed.
Author (TAB)

N68-24633 Joint Publications Research Service, Washington, D. C.
PERCEPTION OF SPACE AND TIME IN OUTER SPACE
A. A. Leonov and V. I. Lebedev 23 May 1968 16 p Transl. into ENGLISH from the book "Vospriyatiye Prostranstva i Vremeni v Kosmose" USSR, 1968 p 69–74, 99–105
(JPRS-45478) CFSTI: $3.00

CONTENTS:

1. TRAINING OF COSMONAUTS FOR ORIENTATION IN SPACE A. A. Leonov and V. I. Lebedev p 1–7 (See N68-24634 14-05)

2. COSMIC FLIGHT WATCH-STANDING AND PSYCHO-PHYSIOLOGICAL RHYTHMS A. A. Leonov and V. I. Lebedev p 8–15 (See N68-24635 14-04)

N68-24634 Joint Publications Research Service, Washington, D. C.
TRAINING OF COSMONAUTS FOR ORIENTATION IN SPACE
A. A. Leonov and V. I. Lebedev *In its* Perception of Space and Time in Outer Space 23 May 1968 p 1–17 (See N68-24633 14-05)

An overview is presented on some of the techniques used in conditioning the vestibular apparatus of cosmonauts. These include active and passive exercises to increase resistance to stimulation under various conditions, and to develop plasticity in the functions of the central nervous system. Flight simulation is discussed, along with the importance of bimedical monitoring and psychological observations. The problems of overcoming preflight tensions are considered, and the value of parachute training in developing psychological resistance to extreme and usual situations is stressed. M.G.J.

N68-24756*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
FLAMMABLE AND TOXIC MATERIALS IN THE OXYGEN ATMOSPHERE OF MANNED SPACECRAFT
John H. Kimzey Washington May 1968 30 p refs
(NASA-TN-D-3415) CFSTI: HC $3.00/MF $0.65 CSCL 05E

A preliminary study of the considerations necessary in selecting materials for use in an oxygen-rich atmosphere revealed that a major design effort must be directed toward reducing the toxic and flammable contaminants of the atmosphere. The effect of zero gravity in preventing convection is one aspect of research that deserves considerable effort since heat transfer and flammability are two major fields directly affected. Other research is needed in human tolerances, static electricity, removal of low-molecular-weight gas, fire extinguishment, overall characteristics of materials exposed for long periods in pure oxygen, and in the development of adequate test procedures. Author

N68-24871# Royal Air Force, Farnborough (England). Inst. of Aviation Medicine.
RECENT WORK ON OXYGEN RICH FIRES
D. M. Denison *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 7 p refs (See N68-24859 14-04)

Research on oxygen rich fires which is being undertaken in America and Great Britain is summarized. Examined are studies in the following areas: ignition in oxygen; the spread of fires in oxygen; methods of extinction; problems of hyperbaric oxygen therapy; and codes of practice. S.C.W.

N68-24872*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HUMAN-FACTORS ASPECTS OF ORBITAL OPERATIONS
A. W. Vogeley *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 24 p (See N68-24859 14-04)
CSCL 05E

This paper presents a comprehensive review of the human-factors aspects of orbital operations required to support a manned orbital laboratory. Based on a detailed operational analysis of what will be demanded of man in such a space system, the paper establishes a reference framework and a set of goals for human-factors research—many of which will require strong biomedical and biotechnological support. Also, since most space station activities require a combination of several specific manual operations, a matrix of these interrelationships is developed. Finally, this matrix is combined with a best-estimate schedule of station activities (heavily dependent upon progress in physical sciences technology) to yield a priority list for human-factors research. Author

N68-24873*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STATUS REPORT ON RECENT LANGLEY STUDIES OF LUNAR AND SPACE STATION SELF-LOCOMOTION
Donald E. Hewes *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 16 p refs (See N68-24859 14-04)
CSCL 05H

Reviewed are studies of the self locomotive capabilities of astronauts both on the lunar surface and in rotating space stations. The lunar locomotion studies are being carried out both by in-house effort and by contract with aerospace industries using an inclined-plane technique developed for simulating lunar gravity. Initial in-house studies showed that there were significant differences between earth and lunar locomotive gait characteristics and that in general a gravity level equal to that of the moon had a favorable effect on these locomotive capabilities. Space station studies utilize a simulator capable of rotation which together with the inclined plane technique provides weightless and rotational conditions. It was observed that subjects could initiate and sustain a walk at gravity levels below 0.2 times earth's gravity. In addition to walking, space soaring could be employed under these conditions. The most significant comments relative to these two on-going projects is that there seem to be significant differences between self locomotion, involving rectilinear motion, as typified by walking on the moon or

in a space station with flat floors; and self locomotion involving curvilinear motion as in the case of the space station with floors curved about the axis of rotation. It is therefore surmised that care should be exercised when attempting to speculate on the problems of locomotion in one medium on the basis of experience in the other. S.C.W.

N68-24878# Army Research Inst. of Environmental Medicine, Natick, Mass. Military Ergonomics Lab.

SYSTEMATIC EVALUATION OF THERMAL ASPECTS OF AIR CREW PROTECTIVE SYSTEMS

Ralph E. Goldman *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 20 p refs (See N68-24859 14-04)

The systematic study of a proposed uniform begins with an analysis of the insulation (clo) and evaporative transfer (i_m) properties of the basic fabrics, individually and subsequently as the composite layers in the uniform system. These initial fabric investigations are carried out both on a dry, and a wetted, heated flat plate. The uniform items are then evaluated on an anthropomorphic heated and sweating manikin so that the insulation and evaporative properties of the uniform, as worn, can be evaluated. A computer model for human thermal balance is then programmed with these values and the tolerance range for wear of such a uniform is calculated as a function of wearer workload, ambient temperature, vapor pressure, wind velocity and solar load. The results are plotted on a psychrometric chart. Finally an environmental chamber evaluation of the ensemble may be carried out with volunteer subjects, at one of the critical points suggested by the computer prediction, to confirm the predicted stress level and investigate other human factors aspects. Our experience has been that the stress level found in such an evaluation is almost always in agreement with that predicted from the clo and i_m indices. Author

N68-24879# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.

AIR CREW PROTECTIVE TECHNIQUES FOR HOT HUMID ENVIRONMENTS

R. Gaudio, M. McCally, W. C. Kaufman, and N. Abramson *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 10 p refs (See N68-24859 14-04)

Cockpit temperatures of 54°C with 40-50% Relative Humidity are not unusual in Southeast Asia. In an attempt to minimize the physiologic changes that occur during exposure to such an environment three simple protective devices were studied: (1) a water cooled vest, (2) the effect of breathing cool-dehumidified air and (3) the administration of the steroid blocking agent—metapyrone (R) In evaluation of each device, five subjects were exposed to heated environments similar to those encountered in Southeast Asia both with and without the addition of each of the protective devices. It is demonstrated that the water cooled vest significantly improves both thermal tolerance and the physiologic responses to a hot humid environment. Breathing cool dehumidified air significantly reduces the ventilatory response to heat stress but is not protective otherwise. Metapyrone administration reduces the excretion rate of sweat Na in response to heat stress but it also is not thermally protective. Author

N68-24880# Air Force Systems Command, Brooks AFB, Tex. Aerospace Medicine Div.

RECENT ADVANCES IN THE DEVELOPMENT OF MEDICAL EQUIPMENT AND MATERIEL FOR MILITARY AEROSPACE OPERATIONS

John E. Murphy and Bruce H. Warren *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 11 p refs (See N68-24859 14-04)

Exploratory and engineering research focusing on the development of facilities needed to provide medical support at remote and logistically isolated bare bases (logistically remote and isolated areas), and the development of medical equipment for use in the movement of patients in the aeromedical evacuation system; is reported. Discussed is the development of a new air transportable self-contained tactical treatment facilities system. The facility embodies the most advanced professional and technical devices ideally positioned for use in the most suitable shelter environment conducive to patient recovery and worker efficiency. The system is designed for easy and rapid transport and positioning and can be deployed in three C-130 aircraft. The facilities are designed primarily as air transportable structures, with ground mobility performance being limited accordingly. Improved equipment for the aeromedical evacuation system includes the development of a functional sphygmomanometer; portable oxygen system; bacterial isolation unit; humidifier-nebulizer; litter support system; patient access unit; and exploratory study of an intensive care unit. S.C.W.

N68-24881# Institute of Aviation Medicine, Toronto (Ontario).

FLASH BLINDNESS—DEVELOPMENT AND TRIALS OF PROTECTIVE SPECTACLES

Bryan St. L. Liddy and Clement Mc Culloch *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 6 p ref (See N68-24859 14-04)

Tests and flight trials of blinker glasses designed for use in a hypothetical tactical situation involving the exposure of low flying pilots to multi-detonations of small yield weapons within relatively short time periods are discussed. Evaluated is the feasibility of the assumption that by wearing the blinker type glasses uninterrupted macular and hemiretinal function would be maintained at all times by one eye or the other despite exposure to scotoma producing high intensity light. The blinker glasses were tested for effectiveness against high intensity flash using the following criteria for protection: (1) ability to read 6/18 line on a test chart, and (2) ability to check and correctly read flight instruments in a simulated cockpit. The light source used consisted of N22 aluminum foil bulbs with a peak luminance of 4,200,000 lumens and a duration time of 50 milliseconds. Tested were ten subjects possessing uncorrected visual acuity of 20/20 in each eye. The ten subjects had a uprotected 6/18 recovery time of between 34 to 150 seconds, the average being 43 seconds. The angle of incident light made little difference as long as it subtended more than 10° from central fixation using the 6/18 visual angle criteria. Flight tests showed that: (1) It is feasible to wear blinker type glasses in flight should this be required; and (2) pilot acceptance of this type of protective device will depend on familiarity with the glasses, coupled with a continued unit training program stressing the nature and consequences of flash blindness as well as protective techniques currently available. S.C.W.

N68-24882# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.

A REVIEW OF SOME RECENT AND CURRENT EXPLORATORY DEVELOPMENT EFFORTS IN PRESSURE SUIT TECHNOLOGY

Erwin R. Archibald *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 27 p refs (See N68-24859 14-04)

Fundamental physiological and environmental problems affecting the design of full pressure suits are discussed and research and development efforts leading to the conceptual design of a hybrid second generation extravehicular space suit, and the Boyle's law partial pressure suit are reviewed. Main characteristics of major types of pressure suit joints and biomedical requirements that pressure suits must satisfy are briefly considered. S.C.W.

N68-24885# Belgian Air Force, Brussels.

CRITICAL STUDY AND STATISTICS OF THE VALUE OF DIVERSE ATTENTION TESTS USED FOR THE SELECTION OF PILOTS [ETUDE CRITIQUE ET STATISTIQUE DE

LA VALEUR DE DIVERS TESTS D'ATTENTION UTILISES POUR LA SELECTION DES PILOTES]

Paul Lievens *In* AGARD Behavioural Probl. in Aerospace Med. Oct. 1967 21 p refs In FRENCH (See N68-24859 14-04)

Speed, precision, and maximum time dispersion for range were studied in relation to the performance of 447 Belgian student pilots and their success and failure at different levels in training. Norms established and actually used for Dutch pilots were modified for the Belgian population and the system for correcting tests was reviewed. There were significant differences between subjects who succeeded and those who failed, related more to accuracy at the beginning of training and to other factors at other levels of training. Subjects who obtained the pilot certificate were distinguished from those who failed by a fewer number of omissions during performance at average speed. It is concluded that the most important factor in the testing of attention is the accuracy achieved during performance or the attention to detail. Transl. by M.W.R.

N68-24914*# Aerospace Medical Div. Aerospace Medical Research Labs (6570th), Wright-Patterson AFB, Ohio.

INVESTIGATION OF THE EFFECTS OF VIBRATION ON DIAL READING PERFORMANCE WITH A NASA PROTOTYPE APOLLO HELMET Final Report, Dec. 1965–Mar. 1966

Richard W. Shoenberger Feb. 1968 14 p refs
(NASA Order R-58)
(NASA-CR-94655; AMRL-TR-67-205) CFSTI: HC $3.00/MF $0.65 CSCL 05H

Dial reading performance was investigated during short duration whole-body sinusoidal vibration. The subjects were in the semisupine position so that the force of gravity acted through the X-axis of the body, with the vibration acting in the X-axis in one experiment and in the Y-axis in another. Dial reading was assessed at 6, 11, and 15 Hz when the helmet was worn either with or without a helmet liner. The vibration intensity was ±1.2G in the X-axis experiment and ±0.9 G in the Y-axis experiment. Static control measurements were also made both with and without the helmet. The results showed significant decrements in dial reading performance during vibration which were differentially related to direction of vibration, frequency of vibration, and to combinations of liner versus no liner with the three frequencies. The results further indicated that the effects of different directions and frequencies of vibration were quite similar to those found under the same conditions using a Mercury helmet without a face plate. The data suggested that performance was somewhat poorer during both vibration and static conditions with the Apollo helmet. This is probably the result of visual interference produced by the curvature of the helmet face plate and by small scratches and blemishes on the face plate. Author

N68-25022 Johns Hopkins Univ., Baltimore, Md.

A QUANTITATIVE DESCRIPTION OF VOLUNTARY EYE MOVEMENTS IN THE MONKEY

Albert Frederick Fuchs (Ph.D. Thesis) 1966 161 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-2995

A technique is described which enables eye movements to be measured in the chronic unanesthetized monkey over a range of ±20° with a sensitivity of 1.5 min of arc. A training procedure is illustrated which conditions the animals to make specific eye movements on command. It is found that no qualitative difference exists between similar human and simian eye movement trajectories. Therefore, a monkey preparation can now be used for neurophysiological studies of the oculomotor system with confidence that the results of such studies have considerable relevance to the human oculomotor system. Dissert. Abstr.

N68-25060*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A PIEZOELECTRIC TRANSDUCER FOR MEASURING CARDIAC AND GROSS MOTOR ACTIVITY OF SMALL ORGANISMS

Vernon L. Rogallo, Robert S. Jenkins, and Gordon J. Deboo Washington May 1968 11 p refs
(NASA-TN-D-4590) CFSTI: HC $3.00/MF $0.65 CSCL 06B

The transducer system incorporates both mechanical and electrical noise rejection features. The mechanical feature is achieved by a dual arrangement, essentially two transducers, one of which senses the organism activity and noise while the second senses only the noise. Subtraction of the output of the individual transducers results in a cancellation of the environmental noise. The electrical noise rejection is achieved by low-noise preamplifiers with differential input to reject 60 Hz. A low-noise-RC-active filter is used to eliminate frequencies outside the bandwidth of interest. It was found that the rejection features provided sufficient discrimination against environmental noise to allow the transducer to be used in a normal laboratory environment. The instrument is sufficiently sensitive to measure heart rates in insects, reptiles, mammals, and developing chick embryos as young as 3 days. Author

N68-25068# Instituto de Energia Atomica, Sao Paulo (Brazil). Servico de Protecao Radiologica e Dosimetria.

CALIBRATION OF DU PONT FILMS OF TYPE 508 AND 510 BY BETA RADIATION [CALIBRACAO DOS FILMES DUPONT TIPO 508 E 510 PARA A RADIACAO BETA]

Gian Maria A. A. Sordi and Dirceu M. Vizeu Apr. 1967 25 p refs In PORTUGUESE; ENGLISH summary
(IEA-141) CFSTI: HC $3.00/MF $0.65

The question of determining the beta exposure from different energies that in general occurs simultaneously with gamma radiation, is important mainly for people involved with chemical processing, radiobiology, medicine, etc. The main difficulty in the calibration of the film is the calculation of exposure from beta sources, because the existing analytical expressions are not applicable directly in most of the exposure conditions. After a brief discussion concerning the election of the analytical expression used, a program for the IBM-1620 II computer is shown. The selection of the radioisotopes, the experimental arrangement and the results are discussed. Some considerations on the minimum energy that can be detected are also made. The comparison of the response curve for beta with that of gamma radiation from Co-60 shows that it is possible to find out the exposition, to know if it came from gamma or beta plus gamma radiation and also to give an approximate value for the average effective energy of the incident radiation. Author

N68-25276*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

A COMPARISON OF HUMAN RESPONSE MODELING IN THE TIME AND FREQUENCY DOMAINS

Lawrence W. Taylor, Jr. [1967] 41 p refs Presented at the USC-NASA Conf. on Manual Control, Los Angeles, 1–3 Mar. 1967
(NASA-TM-X-59750) H-464) CFSTI: $3.00/MF $0.65 CSCL 05H

A review is made of frequency and time domain methods of analyzing human control response while performing compensatory tracking tasks. Sample linear model results are compared and discussed. The frequency domain consists of smoothing with respect to frequency, where the constraint for the time domain model is more natural and meaningful in that it consists simply of limiting the memory of the pilot model. The linear models by both methods were almost identical. The time domain method of analysis enables the determination of a nonlinear pilot model. The inclusion of a cubic as well as a linear term accounted for only a small additional part of the pilot's remnant, and indicated that only a small portion

of the total power of the pilot's output is caused by nonlinearities. The power spectral density of an ensemble average of pilot's output is used to determine the upper limit on the amount of power associated with a deterministic response. The indication is that more than half of the remnant using a linear model is stochastic in nature. Author

N68-25336*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PILOT RESPONSE IN COMBINED CONTROL TASKS
Hugh P. Bergeron 28 Sep. 1967 18 p refs Presented at Human Factors Soc. 11th Ann. Meeting, Boston, 25–28 Sep. 1967
(NASA-TM-X-60499; L-5759) CFSTI: HC $3.00/MF $0.65 CSCL 05H

Pilot response in a multi-task simulation, which consisted of a primary control task combined with one or two secondary or side control tasks, was investigated. A general description of the response characteristics of each of these tasks was obtained and this information was used to determine the workload requirements of the tasks. Two different control tasks were used as the primary control task, either a fixed-base simulation of a lunar letdown or a simplified multi-loop tracking task which was similar to the end portion of the lunar letdown. The simplified tracking task was used in lieu of the more complicated lunar letdown because it could be represented and reproduced analytically. The secondary or side tasks consisted of a system failures task and a motor response task. The system failures task was incorporated from those systems present in a vehicle known as the Mercury Procedures Trainer. The motor response task was similar to that presented by the late Dr. Fitts of the University of Michigan. The task consisted of using a pencil-like device to make impacts on two separated, restricted columns. Author

N68-25339*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PILOTED SIMULATOR DISPLAY SYSTEM EVALUATION: EFFECTIVE RESOLUTION AND PILOT PERFORMANCE IN THE LANDING APPROACH
Wendell D. Chase [1967] 24 p refs Presented at USC-NASA Conf. on Manual Control, Los Angeles, 1–3 Mar. 1967
(NASA-TM-X-59806) CFSTI: HC $3.00/MF $0.65 CSCL 05H

Results are reported from a study conducted to investigate the quality of a visual display in a fixed cockpit piloted simulator and ways of measuring pilot-vehicle performance. The effective resolution characteristics of the simulator display system are presented for several pilots and compared with those for the real world. The pilot's ability to estimate range and altitude with a simulator display was determined, and his ability to control the vehicle in the approach and landing was measured. A correlation analysis between the various measures of altitude-range estimates, and pilot-vehicle performance showed that (1) the touchdown error depends on the pilot's ability to judge altitude in the landing approach, and (2) the touchdown error is highly correlated with the integrated altitude error. The correlation indicates difficulty in estimating the correct altitude to decrease the rate of descent and to initiate the flare. It also stated that the absence of motion feedback, ground effect dynamic forces, and vestibular and kinesthetic cues may be partially responsible for these errors. B.S.D.

N68-25357# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
HEALTH PHYSICS AND MEDICAL DIVISION PROGRESS REPORT, JANUARY–DECEMBER 1967
J. E. Johnston, Ed. Feb. 1968 62 p refs
(AERE-PR/HPM-12; HL68/925) HMSO: 12s

Studies dealing with aerosols, radiation physics, metabolism, and human biology and biological research are reviewed. Researches on aerosols deal with mondisperse polystyrene particles, atmospheric pollution, and the physical and chemical aspects of aerosols. Neutron dosimetry and radiophysics were considered; as were personnel dosimetry, radiation spectrometry and computer processing, and fallout. Metabolic studies were concerned with the measurement of plutonium; retention of alkaline earths; the actinides, cesium, and potassium; neutron activation in vivo, iron absorption, and absorption of beta particles in the bone. Inhalation, tritium, and asbestos studies were also undertaken; and a symposium on bioassay methods is reported along with clinical pathology and radiology efforts and an ischaemic heart disease survey. M.W.R.

N68-25385*# TRW Systems, Redondo Beach, Calif.
MEASUREMENTS REPORT: THERMAL PROPERTY MEASUREMENTS OF MANNED SPACECRAFT CENTER SPACESUIT MATERIALS
F. J. Turnbow May 1968 3 p ref
(Contract NAS9-3670)
(NASA-CR-92133; Rept.-68-3346.11ja-34) CFSTI: $3.00 CSCL 06Q

Near-normal emittance measurements from space suit materials were made with an infrared reflectometer. While the measurements are of limited absolute accuracy, their relative accuracy is generally ±0.02; and therefore the measurements in conjunction with calorimetric or other accurate absolute methods are considered extremely useful for scanning large quantities of similar materials. Results are included for quarter-mil aluminized Kapton space suit material, as well as for sun visor and protective visor taken at two-inch intervals in both a lateral and vertical direction. M.W.R.

N68-25428# Joint Publications Research Service, Washington, D. C.
BIONIC ASPECTS OF AUTOMETRY
K. B. Karandeyev, V. N. Okhotskaya, B. I. Puchkin, and M. P. Tsapenko 21 May 1968 14 p refs Transl. into ENGLISH from Avtometriya (USSR), Sep.–Oct. 1967 p 119–128
(JPRS-45444) CFSTI: HC $3.00/MF $0.65

Structures of biological models for gathering and processing of information are discussed, and the analyzers in the living organism are realized through the use of very complex structures consisting of a great number of elements. It is felt that the utilization of the functional and structural features of biological analyzers to find new ways to create information measuring systems (IMS) may essentially change the characteristics of modern measuring technology. Research is needed in designing new elements, means of creating methods in the areas of designing new elements, actual creating of methods and means of measurement, and synthesizing the systems in which the gathering and processing of IMS's is accomplished. The peripheral section of the biological analyzer system (BAS), including modeling methods, must be studied, along with the BAS neuron networks and the orienting reactions of the BAS. M.W.R.

N68-25429*# National Aeronautics and Space Administration, Washington, D. C.
NASA ASTRONAUTS
Oct. 1967 42 p
(NASA-EP-34) GPO: HC $0.35; CFSTI: MF $0.65 CSCL 05H

A review of the NASA manned space flight programs is presented, and a brief discussion of astronaut training is followed by biographical sketches of all astronauts. K.W.

N68-25521*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
LIFE SUPPORT SYSTEMS INTEGRATION
Warren D. Hypes 18 Aug. 1967 41 p refs Presented at Va. Polytech. Inst. Conf. on Bioastronautics, Blacksburg, Va., 14–18 Aug. 1967
(NASA-TM-X-60421) CFSTI: HC $3.00/MF $0.65 CSCL 06K

Achieving an optimized design of regenerative Environmental Control and Life Support (EC/LS) systems requires integration at three levels: (1) sub-system; (2) system; and (3) total spacecraft. Two types of subsystem level integration are desirable: process integration which interfaces mass transfer, reaction rate control, and phase separation techniques; and operational mode integration which interfaces selected techniques and design schemes for producing system operational flexibility. System level integration is paced by thermal balance considerations involving the techniques of supplying heat to the endothermic processes and coolant to the system hardware and cabin environment. At the total spacecraft level, integration occurs most intimately between the EC/LS system, the power system, and the thermal control system. The common denominator for these three systems is energy in the form of heat. Tests were conducted on a full-scale, research model integrated system. The tests indicated that the regenerative processes are feasible, but extensive development of subsystems hardware is necessary before regenerative systems can be applied to flight vehicles. Author

N68-25600*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATION OF HUMAN TRANSFER FUNCTIONS TO A DESIGN PROBLEM
James J. Adams [1967] 22 p ref Presented at the USC-NASA Conf. on Manual Control, Los Angeles, Calif., 1–3 Mar. 1967
(NASA-TM-X-59607) CFSTI: HC $3.00/MF $0.65 CSCL 05H

An analytical design study was made of a proposed full-scale, manually controlled lunar landing simulator using analytical transfer functions for the pilot control response along with the analytical representation for the mechanisms. The simulator reproduced the lunar environment by supporting five-sixths of the weight of the test vehicle with an overhead cable. The cable was kept directly over the test vehicle by the automatic control of the longitudinal drive mechanism of the simulator. The results showed that the dynamic characteristics of the simulator that could be expected in the actual system were in a range that would influence the response of the manually controlled systems which were to be tested. When the simulator was put in operation, the results of the analytical study were checked. The simulator was operated with the gain of the longitudinal drive set as high as was feasible with the actual mechanism and with a low gain to determine if this change would affect the pilot's response. The pilots reported that the degraded system was more difficult to control, and the records clearly showed a decrease in system damping with the degraded system. Author

N68-25604# Louisville Univ., Ky.
TRANSFORMATIONAL PROCESSES AND REMEMBERING. ORGANIZATIONAL PROCESSES IN MULTITRIAL FREE RECALL Final Report
John A. Robinson 1 Feb. 1968 10 p refs
(Grant AF-AFOSR-1008-66)
(AFOSR-68-0528; AD-666686)

Two types of problems were investigated: (1) The role of encoding and decoding rule learning and rule interference in what is, ostensibly, a nonsense--anagram list learning experiment; (2) the nature and role of organizational processes in multitrial free recall. The materials used in these experiments were codeable trigrams (e.g. RJA; JAR) and categorizeable words (e.g. flute, trumpet; week, day, etc.). The results of seven experiments on coding produced the following conclusions: (1) Subjects do learn and use both encoding and decoding rules. (2) Intralist encoding or decoding rule interference is a significant determinant of performance. (3) Sufficient structure can be built into these anagram materials to completely offset what have been assumed to be the detrimental effects of coding. The results of the experiments in free recall document the occurrence of intercategory organization (CO) as well as the more familiar intracategory organization. Using techniques from graph theory it was possible to show that the degree of CO observed is greater than chance, and that CO is highly correlated with category recall. One theoretical conclusion of special interest was that hierarchical models of retrieval are inadequate as an explanation of these data. Author (TAB)

N68-25611*# Illinois Univ., Urbana. Biological Computer Lab.
STRUCTURAL AND DYNAMIC ASPECTS OF SPEECH SIGNALS Interim Scientific Report
Ian B. Thomas (Mass. Univ.) 15 Apr. 1968 13 p refs
(Grant NGR-14-005-111; Contract AF 33(615)-3890; Grants AF-AFOSR-7-66; AF-AFOSR-7-67)
(NASA-CR-94706; BCL-7.3) CFSTI: HC $3.00/MF $0.65 CSCL 06D

It has been shown that distorted natural speech, in which all formant information except the second formant frequency has been suppressed, yields articulation scores as high as 92% for monosyllabic English words out of context. Whistled speech, in which the period of a multi-vibrator is controlled by a second formant tracker, yields articulation scores near zero. If a random noise source, or a source with period equal to the glottal rate is used to vary the zero-axis crossing times of the whistled speech, the sounds become speech-like and articulation scores increase. The spectrograms for these three approximations to speech are virtually indistinguishable. It appears that the gross formant structure (dynamic information) conveys the word-based cues necessary for distinguishing among different sounds, whereas the excitation (structural information) conveys the cue that the sound is indeed a speech sound. Author

N68-25626# Los Alamos Scientific Lab., N. Mex.
PROBABILISTIC SCHEME FOR PREDICTING AND EVALUATING HAZARDS RESULTING FROM RADIOACTIVE EMISSIONS TO THE ATMOSPHERE
Robert U. Fultyn [1968] 23 p refs Presented at the Health Phys. Soc. Midyear Topical Symp., Environ. Surveilance in Vicinity of Nuclear Facilities, Augusta, Ga., 25 Jan. 1968
(Contract W-7405-ENG-36)
(LA-DC-9094; CONF-680108-5) CFSTI: HC $3.00/MF $0.65

A probabilistic analysis scheme for predicting and evaluating hazards resulting from radioactive emissions to the atmosphere is presented which will allow a greater number of variables to be included in the evaluation. Therefore, it is believed to be a more accurate method than the present system based on limited samplings of fission products. NSA

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N68-24351# Mound Lab., Miamisburg, Ohio.
THE DISPROPORTIONATION OF PU(IV)
Gary L. Silver 29 Feb. 1968 7 p refs
(Contract AT(33-1)-GEN-53) CFSTI: HC $3.00/MF $0.65
(MLM-1482) CFSTI: HC $3.00/MF $0.65

The stoichiometry of disproportionation of Pu(4), corrected for small amounts of pentavalent plutonium generated by the disproportionation reaction in a few typical acids, is presented in tabular form. Author (NSA)

N68-24376# International Union of Pure and Applied Chemistry. Basle (Switzerland). Commission on High Temperatures and Refractories.
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED

STATE. VOLUME 1968, NUMBER 1: JANUARY, FEBRUARY, MARCH 1968

J. J. Diamond (Ed.—NBS, Wash., D. C.) Mar. 1968 78 p refs

A bibliography on the high temperature chemistry and physics of materials in the condensed state lists references from the literature of the United States and many foreign countries. These references are given under the headings of devices for achieving temperatures above 1500°C, devices for measuring and controlling temperatures above 1500°C, and devices for physical measurements at temperatures above 1000°C. Properties at temperatures above and below 1000°C are referenced for metallic, nonmetallic, and mixed materials which melt above 1500°C; and properties of metallic and nonmetallic materials which melt below 1500°C are considered at temperatures above 1000°C. Phase equilibria and reactions at temperatures above 1000°C are other categories for which references are given. M.W.R.

N68-24383# Oak Ridge National Lab., Tenn. Isotopes Development Center.

CERIUM-144 DATA SHEETS

S. J. Rimshaw and E. E. Ketchen Nov. 1967 30 p refs

(Contract W-7405-ENG-26)

(ORNL-4185) CFSTI: HC $3.00/MF $0.65

Extensive chemical, physical, and mechanical property data are given for ^{144}Ce in the form of cerous oxide (Ce_2O_3), cerium oxysulfide (Ce_2O_2S), cerium sulfide (Ce_2S_3), and cerous fluoride (CeF_3). Included in the data are: specific activity vs. cooling time; radio-nuclidic abundance; specific power, radiation properties; density; coefficient of thermal expansion; specific heat; enthalpy; phase transformations; thermal conductivity; thermal diffusivity; mechanical properties; biological tolerances; shielding data; heat of formation; free energy of formation; and entropy. NSA

N68-24415# European Atomic Energy Community, Karlsruhe (West Germany).

THE STUDY OF TRANSPLUTONIC ELEMENTS: RESULTS, PROBLEMS AND POSSIBILITIES [DIE UNTERSUCHUNG VON TRANSPLUTONIUMELEMENTEN: ERGEBNISSE, PROBLEME UND MOEGLICHKEITEN]

W. Mueller Mar. 1968 89 p refs In GERMAN; ENGLISH summary

(EUR-3893.d) CFSTI: HC $3.00/MF $0.65

The preparation, some properties, and possible applications of transplutonium elements available in gram and multigram amounts are described. Scientific and practical problems associated with the investigation of these elements or their compounds are discussed. Author

N68-24430 Akron Univ., Ohio.

THERMAL POLYMERIZATION

Bernard Francis Losekamp (Ph.D. Thesis) 1966 150 p

Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-2774

An attempt was made to use the techniques of vapor phase chromatography and thin layer chromatography to obtain information about the mechanism of the initiation step in the thermal polymerization of styrene. The thermal polymerization of styrene in the presence of p-benzoquinone leads to a complex mixture of at least eight separable products. Several of these were shown to be derived from the decomposition of benzoquinone in the presence of radicals. One of the major products of the styrene-benzoquinone reaction was a copolymer containing styrene, quinone and hydroquinone units in the approximate ratio 3:2:2. Studies on the rate of thermal polymerization of styrene-$\underline{\alpha}$-d, showed that the rate determining step involved in the thermal initiation process does not involve hydrogen transfer from the $\underline{\alpha}$-position of styrene. Dissert. Abstr.

N68-24438# Comision Nacional de Energia Atomica, Buenos Aires (Argentina).

SPECTROPHOTOMETRIC DETERMINATION OF THE CONCENTRATION OF COLLOIDS OF GOLD [DETERMINACION ESPECTROFOTOMETRICA DE LA CONCENTRACION DE COLOIDES DE ORO]

R. A. Caro (Buenos Aires Univ.), J. O. Nicolini, and R. Radicella 1967 13 p refs In SPANISH; ENGLISH summary

(CNEA-200) CFSTI: HC $3.00/MF $0.65

A simple procedure for the determination of the concentration of radiogold sols from spectrophotometric data is described. In order to simplify the calculation a nomograph is proposed. Author

N68-24440# International Union of Pure and Applied Chemistry, Basle (Switzerland).

BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND PLASMAS

L. Brewer, comp. (Calif. Univ., Berkeley). 31 Mar. 1968 39 p refs *Its* no. 26

(Rept.-26)

References are given on spectroscopy of interest to high temperature chemistry and on the reaction between gases and condensed phases in a bibliography on the high temperature chemistry and physics of gases and plasmas. A total of 346 titles with authors and sources were taken from the literature of the United States and many foreign countries. M.W.R.

N68-24447 Texas Univ., Austin.

INFLUENCE OF HETEROGENEITIES IN SOLUTION ADSORPTION ON CARBON: OXYGEN AND CRYSTALLITE FACE

Marcellus Theriot Coltharp (Ph.D. Thesis) 1966 212 p

Available from Univ. Microfilms: HC $9.70/MF $3.00 Order No. 67-3265

The effects of surface oxygen coverage and crystallite face on adsorption from methanol–benzene solutions and n-butanol–benzene solutions onto carbon blacks (forms of Spheron-6) were investigated. The chemisorbed oxygen initially present was found to cover 68 percent of the surface and was decreased by thermal decomposition. The Spheron-6 CO_2 decomposition pattern, i.e., the features of a plot of the total amount of the gaseous product appearing in a temperature interval vs. temperature, was found to be different from the patterns for carbons from other sources. The decomposition pattern for CO was found to be similar for all carbons checked. The total chemisorbed oxygen was a measure of the fraction of crystallite edge faces exposed since only an edge carbon can bind an oxygen group. Dissert. Abstr.

N68-24472# Joint Publications Research Service, Washington, D. C.

PROBLEMS IN SURFACE CHEMISTRY AND THE MOLECULAR THEORY OF ADSORPTION

A. V. Kiselev 24 May 1968 52 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 41, no. 10, 1967 p 2470–2504

(JPRS-45491) CFSTI: $3.00/MF $0.65

Experimental foundations of the development of the molecular theory of adsorption are discussed, and problems involved in the use of the molecular theory in studies of adsorbate-adsorbent interactions and adsorbate-adsorbate interactions are analyzed. Results of research on the geometry and chemistry of the surfaces of uniform adsorbents and adsorbates by a complex of different chemical and physical methods and their theoretical treatment have shown that at present the essential experimental foundations are being laid for progress in the theory of adsorption on the molecular level. It is further indicated that in the simplest cases of nonspecific adsorption of the surfaces of nonporous and porous crystals, the molecular-statistical treatment with involvement of the corresponding potential functions has already yielded quantitative

results; however, in more complex cases of specific interactions theory still is at the state of systematization of experimental data obtained by different methods. The need for a general quantum-mechanical and statistical treatment of the problem of the interaction of an assemblage of molecules with an adsorbent, and the need to accumulate new and multifaceted information about adsorption interaction and the state of the adsorbed compound in the form of reproducible physicochemical quantities that are the object of theoretical interpretation and calculation are discussed. S.C.W.

N68-24488# Godudarstvennyi Konitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.
DETERMINATION OF THE OXYGEN CONTENT IN GERMANIUM AND SILICON BY ACTIVATION BY He 3 IONS [OPREDELENIE SODERZHANIYA KISLORODA V GERMANII I KREMNII PRI AKTIVATSII IONAMI GELIYA-3]
G. I. Aleksandrova, A. M. Demidov, G. A. Kotel'nikov, G. P. Pleshakova, G. V. Sukhov et al 1966 15 p refs In RUSSIAN
(IAE-1165)

A method is described for determination of oxygen in germanium and silicon, to be used as a basis for selection of spectrometric detectors. Polished Ge and Si specimens were irradiated with ^{3}He ions in a cyclotron. The surface oxide layer was removed by etching. The O_2 content was determined from the positron activity of ^{18}F as measured in a gamma-gamma coincidence spectrometer with an NaI(Tl) crystal. The possibility is shown of analyzing gallium arsenide, tungsten, silicon carbide, and other materials. A sensitivity of 10^{-7}% is claimed for the method. NSA

N68-24506# Rhode Island Univ., Kingston, Graduate School of Oceanography.
ISOTOPIC ABUNDANCE STUDIES BY NEUTRON ACTIVATION ANALYSIS Summary Report, 14 Apr. 1964–1 Dec. 1967
James T. Corless 15 Jan. 1968 56 p refs
(Contract AT(30-1)-3369)
(NYO-3369-9) CFSTI: HC $3.00/MF $0.65

Studies were made to determine if detectable variations exist in the abundances of the stable isotopes of calcium and if a precise and sensitive technique based on neutron activation analysis could be developed for measurement of these variations. A method for determination of ^{48}Ca in natural calcium by neutron activation methods is described. The sensitivity and precision of this method are comparable to present-day solid-source mass spectrometers. A limited series of analyses indicated that natural variations do exist in the abundances of the stable isotopes of calcium. These variations amount to ≈1%. NSA

N68-24523*# Techtran Corp., Glen Burnie, Md.
MECHANISM FOR THE FORMATION OF SUGARS FROM FORMALDEHYDE, PART 2 [K VAPROSU O MEKHANIZME OBRAZOVANIYA SAKHAROV IZ FORMAL'DEGIDA. 2]
S. A. Balezin Washington NASA May 1968 6 p refs Transl. into ENGLISH from Zh. Obshch. Khim. (Moscow), v. 17, no. 12, 1947 p 2288–2291
(Contract NASw-1695)
(NASA-TT-F-11716) CFSTI: HC $3.00/MF $0.65 CSCL 07C

The author's intent is to reaffirm through closer studies the mechanism for the formation of sugars from formaldehyde which he had proposed earlier, but which was disputed by a critic. The essence of the disagreement is the question of whether the expansion of the volume of the reaction mixture is the result of the thermal effect or is caused by the accumulation of an intermediate product. The author maintains that the latter possibility is indeed the case. He supports his argument with a description of his experimental apparatus, figures, and reaction systems. He reaffirms the validity of his procedures and of the dilatometric method for studying this reaction. He concludes that the thermal changes in the volume of the reaction mixture are insignificant. For this reason the kinetics of the reaction can be considered on the basis of volumetric change. Author

N68-24537# Instituto de Energia Atomica, Sao Paulo (Brazil).
AN ION EXCHANGE EDTA SEPARATION OF LEAD FROM BISMUTH. APPLICATION TO RADIOCHEMISTRY
Alcidio Abrao Dec. 1966 14 p refs In PORTUGUESE; ENGLISH summary Presented at 1st Interam. Conf. on Radiochem., Montevideo, Jul. 1963
(IEA-131) CFSTI: HC $3.00/MF $0.65

A simple and rapid method is suggested for separating lead from bismuth, based on the principle that the Bi-EDTA (Ethylenedinitrilo tetraacetic acid) complex is very stable in acid solutions while lead is not complexed. By percolating a solution of lead, bismuth, and EDTA, the lead ions are completely absorbed by the resin while bismuth is eluted as Bi-EDTA complex. The radiochemical control of the separation by tracers is discussed, and the gamma-ray spectroscopic method for checking the purity of the bismuth fraction is presented. B.S.D.

N68-24543 Ohio State Univ., Columbus.
ELECTROCHEMISTRY OF GLASS-REFRACTORY INTERFACES AND REFRACTORY CORROSION
Bulent Erturk Yoldas (Ph.D. Thesis) 1966 131 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-2567

Some aspects of electrochemistry of glass-refractory interfaces were investigated. The interfacial emf's between the phases of simple oxides of Al_2O_3, SiO_2, ZrO_2, ZrO_2SiO_2, and B_2O_3 glass were measured over a wide range of temperatures. By using simple sodium tetraborate and some commercial borosilicate glasses, the effects of glassy phase and ions in the glassy phase on the interfacial emf were determined. The effect of atmosphere on the interfacial emf temperature curves was also studied by employing oxygen, nitrogen, and water vapor. This investigation was also concerned with emf's of glass-refractory interfaces of industrial refractories, particularly those of zircon with various glasses. The effect of glassy phase and atmosphere on the interfacial emf was studied. A general mathematical expression for the emf of ceramic interfaces was derived for a simple system. Dissert. Abstr.

N68-24546 Ohio State Univ., Columbus.
CHLOROPHYLL A: A STUDY OF ITS AGGREGATION IN CARBON TETRACHLORIDE
George Rappaport (Ph.D. Thesis) 1966 97 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-2518

These investigations, utilizing spectroscopic and vapor pressure osmometric techniques, were extended to demonstrate that chlorophyll-a exists predominantly as a dimer even at the 10^{-5} moles/liter concentration range. The equilibrium constant for dimerization of chlorophyll-a in carbon tetrachloride, consistent with almost complete dimerization, was calculated from visible and infrared spectroscopic data obtained in scrupulously dry systems. The disaggregating effect of moisture was established on a quantitative basis. Equilibrium constant for dimerization calculated from vapor pressure osmometry data was found to be a function of the dryness of the system. Direct infrared spectroscopic evidence was found for the formation of chlorophyll-a–water and chlorophyll-a–methanol complexes. Equilibrium constants for the dissociation of chlorophyll-a dimers by water and methanol were also calculated. Dissert. Abstr.

N68-24547# Bureau of Mines, Reno, Nev. Metallurgy Research Center.
DIRECT ELECTROLYSIS OF RARE-EARTH OXIDES TO METALS AND ALLOYS IN FLUORIDE MELTS

Edward Morrice, E. S. Shedd, and T. A. Henrie Jun. 1968 14 p refs
(BM-RI-7146)

Techniques developed for the preparation of high-purity rare-earth metals and their alloys by electrolysis of the oxides in fluoride media are summarized. Cerium, lanthanum, neodymium, praseodymium, dysprosium, gadolinium, and yttrium metals, the mixture didymium, and specific alloys of these metals and samarium with iron, nickel, chromium, and cobalt were prepared. Individual metals were electrodeposited in the liquid state on tungsten or molybdenum cathodes. Alloys were prepared by electrodepositing the rare-earth metal on a consumable cathode, at a temperature above the melting point of the eutectic formed between the rare-earth element and the cathode material. Cells were designed for electrowinning metal products in gram and pound quantities, and methods for continuous electrowinning of cerium and lanthanum were developed. Author

N68-24548 Pennsylvania State Univ., University Park.
THE MECHANISM OF THE EUTECTOID DECOMPOSITION OF CUBIC SOLID SOLUTIONS IN THE SYSTEM ZrO_2–MgO
Dennis John Viechnicki (Ph.D. Thesis) 1966 200 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-1961

The mechanism of the eutectoid decomposition of cubic solid solutions in the ZrO_2–MgO system was investigated. As a first step the extent of the cubic solid solutions in the system was reinvestigated. Their stability field is larger than previously reported and extends to pure ZrO_2. The eutectoid decomposition of the cubic solid solutions occurs by a mechanism of nucleation and growth of the tetragonal solid solutions on the surfaces of the grains and is accompanied by the diffusion of excess magnesium ions from the region of growth and their precipitation as MgO at the grain boundaries. The formation of the tetragonal solid solutions probably occurs through an intermediate phase in the initial stages of the reaction which later reverts very rapidly to the stable tetragonal solid solutions. The rate of growth of the tetragonal solid solutions is slow and of the order of 10^{-9} cm/sec.
Dissert. Abstr.

N68-24563# Tulsa Univ., Okla. Dept. of Chemistry.
GEOCHEMICAL STUDY OF SOME MANGANESE NODULES
Joan Irene Bacon (M.S. Thesis) 1967 53 p refs
(Contract AT(11-1)-1540)
(COO-1540-8) CFSTI: HC $3.00/MF $0.65

Atomic absorption spectroscopy was utilized in the elemental analysis of 16 manganese nodules. Concentrations were determined for B, Na, Mg, Al, Si, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Sr, Mo, Ag, Ba, Tl, and Pb. Of these, B, Sc, Ga, Ag, Ba, and Tl either were absent from the nodules analyzed or were present in concentrations below limits of detection. Possible linear relationships were noted for Mn–Ni, Mn–Pb, Mn–Mo, Mn–Cr, Cu–Ni, Fe–Si, Fe–Ca, Zn–Ni, Zn–Cu, Ti–Mo, and Ti–Pb. Of the linear trends noted, Mn–Pb, Mn–Mo, and Mn–Cr have not been reported previously. $^{230}Th/^{231}Pa$ and $^{234}U/^{238}U$ radiochemical dating techniques, were used to determine rates of accretion for selected nodules. The $^{234}U/^{238}U$ method indicated a rate of formation of approximately 2.5 mm/10^6 year. This value is in good agreement with data obtained by others using other methods of measurement. Anomalously high rates by the $^{230}Th/^{231}Pa$ method were presumably due to sampling difficulties. Author (NSA)

N68-24610# Joint Publications Research Service, Washington, D. C.
RADIO CHEMISTRY
V. M. Vdovenko, Z. V. Yershova, B. S. Kolychev, and V. V. Fomin *In its* Soviet Atomic Sci. and Eng. 13 May 1968 p 340–361 (See N68-24602 14-22)

The development of radiochemistry is traced, starting with the first investigations on the properties of radioactive radiation and analyses of natural sources of radiation. Consideration is given to the theory of isomorphic cocrystallization, coprecipitation, the laws of distribution for liquid–solid systems and gas–solid systems, the physical constants of the fission reaction, and the technology for processing the ore of various uranium deposits. The difficulties involved in planning the first radiochemical plants are recounted, and the primary technological features of processing radioactive raw material are defined. Consideration is also given to methods of separating radioactive elements, based on the distribution of micro- and macrocomponents between the solid and liquid phases and between two nonmiscible liquids. The safe removal of radioactive wastes is discussed, based on the physical and chemical principles of the behavior of isotope mixtures with variable compositions in various chemical media. M.G.J.

N68-24625# Sandia Corp., Albuquerque, N. Mex.
A MODEL FOR ESTIMATING THE DISTRIBUTION OF CATIONS IN MULTICOMPONENT ION EXCHANGE REACTIONS
R. A. Sallach Dec. 1967 22 p refs
(SC-RR-67-861) CFSTI: HC $3.00/MF $0.65

The model developed by Langmuir for the adsorption of gases on solids was adapted and applied to cation-exchange phenomena. The relationship between the amount exchanged on the surface and its concentration in solution is expressed in terms of mass-action-type equilibrium constants. After considering all possible exchange reactions and their mutual effects, an analytic expression was deduced describing the experimentally defined distribution coefficient in terms of the equilibrium constants and concentrations of the various cations, and of the cation-exchange capacity of the mineral. Good qualitative agreement with experimental results was found for those minerals in which exchange is truly a surface phenomenon. Quantitative comparisons are difficult because a reference ion common to all experiments is lacking. Author (NSA)

N68-24629# Michigan State Univ., East Lansing.
RADICALS IN IRRADIATED CRYSTALS STUDIED BY ESR SPECTROSCOPY Technical Report, 1 Jan.–31 Dec. 1967
31 Dec. 1967 11 p
(Contract AT(11-1)-1385)
(COO-1385-21) CFSTI: HC $3.00/MF $0.65

Developments are reported for studies on: trifluoromethyl and other radicals in irradiated single crystals of trifluoroacetamide; ESR study of CF_2COO^- radicals in irradiated single crystals of sodium chlorodifluoroacetate; effects of crystal structure on production of radicals in irradiated crystals; ESR studies of radicals in irradiated crystals; trichloromethyl radical in irradiated trichloroacetamide; conversion of $\cdot CH_3$ to $\cdot CH_2COO^-$ in irradiated sodium acetate crystals; irradiated polycrystalline fluorocarbon derivatives; radicals in irradiated amides; radicals trapped in irradiated clathrates; radicals in fluoroacetamide irradiated at 77°K; ESR spectra of octamethylnaphthalene and hexamethylnaphthalene cations; computer analysis of NMR spectra; chlorine quadrupole resonance study of some molecular adducts of phosphorus oxychloride; rhenium pure quadrupole resonance spectrum of potassium perrhenate; NQR study of charge transfer complexes; and point-charge calculations of electric field gradients in crystals. NSA

N68-24641# Minnesota Univ., Minneapolis.
PHOTOCHEMISTRY OF BENZENE VAPOR AT 2062A
Gilbert Gomes 5 Mar. 1968 16 p refs
(Contract AT(11-1)-913)
(COO-913-21) CFSTI: HC $3.00/MF $0.65

A study at 2062Å was undertaken to investigate the effect of vibrational energy content on the disappearance quantum yield and the sensitivity of this yield to pressure of foreign gases. The

photolysis at 2062Å was qualitatively very similar to the reported photolysis at 1849Å. The disappearance of benzene was linear with time to 25% conversion. Two major products were found: a volatile compound and a polymer. The quantum yield for the disappearance was at all pressures lower than at 1849Å. NSA

N68-24665*# American Univ., Washington, D. C.
INVESTIGATION OF ELECTROCHEMISTRY OF HIGH ENERGY COMPOUNDS IN ORGANIC ELECTROLYTES FINAL REPORT, 1 Nov. 1964–31 Jan. 1968
R. T. Foley and F. D. Bogar 31 Jan. 1968 49 p refs
(Grant NGR-09-003-005)
(NASA-CR-94736) CFSTI: HC $3.00/MF $0.65 CSCL 07C

The electrochemistry of high energy compounds in organic electrolytes, specifically organic compounds of high capacity capable of being reduced at high potential was studied. A gas chromatographic technique for analyzing cyclic ester solvents, the clarification of the term "range of electrolysis" and its usefulness as a significant parameter in the analysis of non-aqueous battery systems, the appraisal of reference electrodes and the selection of the Ag/Ag + electrode as the most stable, and the compilation of the literature on the chemical properties of the cyclic esters are reviewed. The chronopotentiometric investigation of type organic compounds suitable for cathode depolarizers was continued. On the basis of potential and capacity nitro compounds are of most interest; m-dinitro-benzene has a high relative capacity. The introduction of chlorine groups onto the aromatic ring allows the acceptance of four electrons. Steric factors are important in the adsorption and electrode reaction. Sulfonyl-bis-benzofurazan-dioxide exhibits reversibility and offers the possibility of developing a rechargeable system. Positive chlorine compounds are relatively unstable in the organic solvents and their electroreduction is controlled by an insoluble product. Author

N68-24667# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
COOLANT PROPERTIES [LES PROPRIETES DU REFRIGERANT]
H. Hannaert and R. Lopes Cardozo 1966 24 p refs In FRENCH Presented at Panel on Use of Org. Liquids as Reactor Coolants and Moderators, Vienna, May 1966
(CONF-660553-4)

The properties of an isomeric mixture of terphenyls of the composition ortho 25 wt.%; meta 71 wt.%; para 3–4 wt.%; and diphenyl <1 wt.% were investigated. This mixture is a by-product of the process for obtaining diphenyl by pyrolysis of benzene. The variations of isomeric content depend mainly on the substances used as cracking catalysts. A number of individual measurements (e.g., of electrical conductivity, surface tension, heat of fusion) were carried out. Measurements were also made using coolant degraded in-pile. These measurements were made taking into account not only the total content of heavy elements but also their composition, based on the distribution of molecular weights. The main stress was laid on viscosity measurements. The satisfactory chemical behavior of this coolant was demonstrated by studying its compatibility with the main materials with which it comes into contact, such as sintered aluminum powder, steel, and uranium carbide. This made it possible to lay down certain tolerances in regard to mineral impurities. A hydrocarbon mixture with a high content of phenanthrene derivatives, obtained by distilling the power-forming residue, was considered as starting fluid. Physical and chemical measurements were also carried out on both the virgin fluid and the degraded fluid. Author (NSA)

N68-24670 Louisiana State Univ., Baton Rouge.
THE ACTIVITY AND OTHER THERMODYNAMIC PROPERTIES OF HYDROCHLORIC ACID IN MONOGLYME-WATER MIXTURES
David Alfred Johnson (Ph.D. Thesis) 1966 111 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-1166

An interest in the problem of the thermodynamics of mixed solvent systems has resulted in the study of the galvanic cell, $H_2|HCl(m)|AgCl–Ag$, in monoglyme-water mixtures at four temperatures and in acetonitrile-water mixtures at two temperatures. Ten solutions ranging in hydrochloric acid concentration from 0.1 to 0.001 molal were studied for each solvent system and at each temperature. The E° values were evaluated for each system by extrapolation of the curve formed by plotting the quantity $E_{obs} + 2RT/F \ln m$ versus $m^{1/2}$. The extrapolation was carried out with the use of a polynomial curve fitting program which utilized the least squares technique. By means of the LaMer–Gronwall extension of the Debye and Hückel theory for symmetrical electrolytes, it was shown that an equation analogous to the type used in the polynomial curve fitting program can be obtained. Results in the acetonitrile-water mixtures were not satisfactory as a steady state at the hydrogen electrode was not attained. The cause of this was thought to be due to the hydrolysis of the acetonitrile by hydrogen ion. The errors in the E° values for the monoglyme-water mixtures were estimated to be ±0.2 millivolts for 8.68 and 17.81 percent monoglyme mixtures, ±0.4 millivolts, ±1.0 millivolts and ± several millivolts for 46.52, 67.03 and 88.80 percent monoglyme mixtures, respectively. The mean activity coefficients of hydrochloric acid were calculated and within the limits of experimental error followed the general trends of other mixed solvent systems. The primary and secondary medium effects were also evaluated. The relative partial molal heat content and heat capacity were evaluated for two systems and followed the trends occurring in other mixed solvents. Dissert. Abstr.

N68-24672# Minnesota Univ., Minneapolis.
REACTION OF BENZENE WITH BROMOBENZENE AND 4-BROMOBIPHENYL: POSSIBLE APPLICATION AS A HIGH SENSITIVITY DOSIMETER
Fumio Hirayama 5 Mar. 1968 11 p refs
(Contract AT(11-1)-913)
(COO-913-23) CFSTI: HC $3.00/MF $0.65

To develop a more useful dosimeter, studies were made on the photochemical reaction between benzene and 4-bromobiphenyl. Both ultraviolet light and gamma radiation were used as excitation sources. At low doses the G-value for production of *p*-terphenyl was calculated to be 0.92. If this G-value persists to lower doses, the reaction can be used to determine doses as low as 6.5×10^{13} eV/g (1 rad). NSA

N68-24679# Minnesota Univ., Minneapolis.
PHOTOCHEMISTRY OF BENZENE IN THE FIRST ABSORPTION BAND
Gilbert Gomes 5 Mar. 1968 21 p refs
(Contract AT(11-1)-913
(COO-913-22) CFSTI: HC $3.00/MF $0.65

Photochemical studies of benzene at 1849 and 2062Å were extended to 2440Å. The primary objective was to measure the disappearance quantum yield to determine its pressure dependence. At 2537Å no disappearance was found at benzene pressures of 5 and 10 torr. At 2440Å benzene disappeared linearly with absorbed quanta to 3% conversion. The relatively slight pressure dependence of the quantum yield at this wavelength is qualitatively consistent with the fall off of fluorescence at high pressures. NSA

N68-24691 Tennessee Univ., Knoxville.
THE ALKALI METAL-LIQUID AMMONIA REACTION AT ROOM TEMPERATURE
Donald Coe Jackman (Ph.D. Thesis) 1966 95 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-1369

The kinetics of reaction of three alkali metals, lithium, potassium and cesium, with liquid ammonia at room temperature have been investigated. The experimental procedure involved placing an alkali metal and liquid ammonia into a Pyrex glass reaction cell which could be sealed so that the rate of reaction could be followed spectrophotometrically at room temperature. Lithium and potassium were found to follow first-order reaction kinetics with liquid ammonia. The cesium-ammonia reaction did not follow first-order kinetics for the first half of the reaction. The potassium-ammonia reaction was found to react the fastest of the three systems. On the basis of the data obtained in standard cells with a breakable diaphragm, it was found that for the three alkali metals studied in liquid ammonia near room temperature the rates of reaction decreased in the order, potassium > cesium > lithium. Dissert. Abstr.

N68-24694 Ohio State Univ., Columbus.
REACTION KINETICS IN THE SOLID-STATE FORMATION OF ZINC ORTHOSILICATE
Isaac Leon Brandon (Ph.D. Thesis) 1966 133 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-2419

The formation of zinc orthosilicate by the solid-state reaction of zinc oxide and silica was investigated in the temperature range of 800°C to 1300°C. Quantitative X-ray diffraction techniques were used to determine the rate of product formation under isothermal conditions. The reaction is initiated after one hour at 850°C, and approaches completion after only ten minutes at 1300°C. The reaction rate increases rapidly above 900°C as quartz inverts to cristobalite. The first stage of the reaction is a zero-order phase boundary process requiring an activation energy of 45,800 calories per mole. This initial reaction is believed to be controlled by the rate of nucleation and growth of the product phase. In the later stages of the reaction, a coherent product layer separates the reacting oxides, and the process becomes diffusion-controlled. The solid-state reaction models of Jander and Dunwald–Wagner are equally valid for describing the kinetics of the diffusion-controlled process. Dissert. Abstr.

N68-24699# Weizmann Inst. of Science, Rehovoth (Israel).
CHEMICAL PHYSICS
S. Lifson et al *In its* Sci. Activities 1967 [1968] p 97–108 refs (See N68-24697 14-23)

Experimental and theoretical studies were made of various molecular properties, ranging from small molecules and condensed phases to bipolymers, and Rayleigh scattering of light from liquids was studied by using lasers. Abstracts of research activities in chemical physics summarize the orientational order in dipolar liquids, impact broadening of the oxygen microwave region, and rotation-translation coupling effect in noble gas crystals containing molecular impurities. Among the other efforts were a statistical mechanical analysis of binding of acridines to DNA, theoretical role of diffusion in controlled chemical reactions, and nuclear quadrupole resonance studies. Band structure effects on itinerant electron magnetism, singlet-triplet formulation for dilute magnetic alloys, and the dielectric properties of delocalized dipoles were also investigated. M.W.R.

N68-24700# Weizmann Inst. of Science, Rehovoth (Israel).
CHEMISTRY
G. M. J. Schmidt et al *In its* Sci. Activities 1967 [1968] p 109–128 refs (See N68-24697 14-23)

Nitroheterocyclic and other potential therapeutic agents, nervous system and anti-inflammatory drugs, and anti-tumor agents found in Israeli flora were studied; as was the activity of sphingolipid cleaving enzymes in patients with leukemia. Models were synthesized for parts of sphingolipids, model steroids and terpenes containing epoxide rings were studied, and improved methods were developed for resolution of optical isomers by gas chromatography. Other chemical studies are concerned with photochemical reactions having potential synthetic applications, quantum yields of isomerization of stilbenes and azobenzenes, and electron transport between two photosystems involved in photosynthesis. Electrical conductivities of organic crystals under both blocking and non-blocking conditions are continuing, and a number of X-ray crystallographic analyses were made in the chalcone and anthracene series. Several macromolecules of biological interest were investigated, and a precision diffractometer was designed and built. M.W.R.

N68-24702# Weizmann Inst. of Science, Rehovoth (Israel).
ISOTOPE RESEARCH
J. R. Gat et al *In its* Sci. Activities 1968 [1968] p 165–187 refs (See N68-24697 14-23)

Mass spectrometric studies were made of transition states in atom-molecule reactions; as were oxygen 17 and proton nuclear magnetic resonance studies of the hydration and complex formation of diamagnetic transition metal and rare earth ions, metal porphyrins and their proteins, and metal oxides. Isotopic and geochemical investigations of the evolution of brackish water source and brine lakes, separation of oxygen 17 and oxygen 19 by fractional distillation of water and thermal diffusion of oxygen, and calcium homeostasis on the tissue level were also studied. Studies were made of the chemistry of the brain, including the effect of learning and activity on the uptake of various labeled compounds by amphibians and some mammals. Attention was also given to nuclear chemistry, surface processes, and the development of instrumentation and analytic techniques for using isotopes. Abstracts of published papers in these areas are included. M.W.R.

N68-24704# Weizmann Inst. of Science, Rehovoth (Israel).
POLYMER RESEARCH
A. Katzir (Katchalsky) et al *In its* Sci. Activities 1967 [1968] p 217–236 refs (See N68-24697 14-23)

Physical and chemical processes that guide the creation, conversion, and interaction of polymers were studied in both natural and synthetic systems; and work was accomplished in statistical mechanics, irreversible thermodynamics, electrochemistry, molecular spectroscopy, surface chemistry, molecular rheology, ultracentrifugation, and light scattering. Both the isolated macromolecule and sophisticated systems in which macromolecules are in strong interactions were considered. Charged hyperfiltration membranes and bacterial peptides were prepared, dimensions of real polymer chains were studied, and solvent extraction chemistry and selective membrane constructions were considered. Other polymer research efforts were concerned with the coupling of an enzymic reaction to trans-membrane flow of electric current, phase separation and temperature-dependent confirmation of polyriboadenylic acid solutions at neutral pH, and transport of ions across lipid monolayers. M.W.R.

N68-24708 Ohio State Univ., Columbus.
A WET METHOD FOR ANALYZING GOLD–SILVER ALLOYS OF HIGH GOLD CONTENT
Lowell William Shank (Ph.D. Thesis) 1966 89 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-2533

This investigation was undertaken to develop a satisfactory wet method for analyzing gold–silver alloys of high gold content that would be convenient for use in a general analytical laboratory where such alloys are infrequently analyzed. Attempts were made to dissolve pure gold in aqua regia and in the following mixtures: sulfuric and nitric acids, hydriodic acid and hydrogen peroxide, hydriodic and nitric acids, and hydriodic and sulfuric acids. It was concluded that of the solvents tried, aqua regia is the best because of the higher rate of attack and because no substances are introduced that interfere with the subsequent determination of gold. In aqua regia, gold is in the form of chlorosurate ion, $AuCl_4^-$. Dissert. Abstr.

N68-24728# United Kingdom Atomic Energy Authority, Harwell (England).
THE SEPARATION OF SMALL QUANTITIES OF MERCURY FROM GROSS AMOUNTS OF SILVER IN NITRIC ACID SOLUTION
B. M. Maude and K. L. Wilkinson Feb. 1968 8 p refs
(AERE-M-2008) CFSTI: HC$3.00/MF$0.65

The methods investigated for the separation and recovery of mg. quantities of stable mercury isotopes from gross amounts of silver in strong nitric acid solution are described. The method adopted was displacement from solution by copper, and recovery of the mercury from the Hg/Ag/Cu alloy by controlled heating in vacuum. Experiments with the natural mercury have shown recoveries in the range 96%–99%. Author

N68-24732*# Techtran Corp., Glen Burnie, Md.
THE COMPOSITION AND THERMAL STABILITY OF RARE EARTH CARBONATES OF THE YTTRIUM GROUP [O SOSTAVE I TERMICHESKOY USTOYCHIVOSTI KARBONATOV REDKOZEMEL'NYKH ELEMENTOV ITTRIYEVOY GRUPPY]
I. N. Tselik, V. Ya. Shvartsman, and V. D. Fedorenko Washington NASA May 1968 10 p refs Transl. into ENGLISH from Zh. Neorg. Khim. (Moscow), v. 13, no. 1, 1968 p 106–112
(Contract NASw-1695)
(NASA-TT-F-11710) CSCL 07B

Details are given on the composition and thermal dissociation of the carbonates of the rare earth elements of the yttrium group, synthesized in accordance with known procedures. The experimental treatments of the tested substances are described and the experimental results are supported by tables, figures and reaction systems. The rare earth element carbonates of the yttrium group decompose in two basic stages, with the exception of Yt and Gd: liberation of water of crystallization with the loss of one CO_2 molecule and the formation of hydroxycarbonates; this stage is characterized by the formation of the respective oxides. The rare earth element carbonates can be decomposed by degrees of thermal stability in a given order. Author

N68-24741 Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
BASE STRENGTH OF VARIOUS NEUTRAL ORGANOPHOSPHORUS EXTRACTANTS
F. Krasovec and C. Klofutar Feb. 1968 6 p refs Submitted for publication
(NIJS-R-519)

Ten neutral organophosphorous compounds were investigated in which the distribution of bis-p-chlorophenyl phosphoric acid between carbon tetrachloride and perchloric acid was measured as function of a neutral organophosphorous compound concentration, and the equilibrium constant of this association reaction was determined. Tabulated data are given on the association constant for some neutral organophosphorous compounds with bis-p-chlorophenyl ester of phosphoric acid in carbon tetrachloride. B.S.D.

N68-24751# Bureau of Mines, Albany, Oreg.
CONVERSION OF TUNSTEN OXYCHLORIDE TO TUNGSTEN HEXACHLORIDE BY CHLORINATION
Arthur W. Henderson, D. H. Yee, and F. E. Block Jun. 1968 18 p refs
(BM-RI-7152)

Methods for converting $WOCl_4$ to WCl_6 were investigated in small-scale, laboratory apparatus to devise a method for preparing pure WCl_6 suitable for conversion to tungsten metal. Chlorine, $COCl_2$, and CCl_4, alone and in combination with various forms of carbon, were tested as chlorinating agents at various temperatures. More than 95 percent conversion of $WOCl_4$ to WCl_6 was achieved with all reagents at 800°C in the presence of activated carbon. Only CCl_4 maintained its effectiveness in the absence of carbon at 800°C. The effectiveness of carbon was found to be related directly to its surface area. Author

N68-24753# Bureau of Mines, Rolla, Mo.
BORON AND BORON CARBIDE BY VAPOR DEPOSITION
James G. Donaldson, James B. Stephenson, and A. A. Cochran Jun. 1968 19 p refs
(BM-RI-7150)

The Bureau of Mines investigated the formation of boron and boron carbide coatings by vapor phase reactions. Optimum parameters were determined for hydrogen reduction of boron trichloride and for the formation of boron carbide coatings on graphite by reaction with the depositing boron. At 1,300°C, about 85 percent of the boron was deposited. Tungsten substrates did not react with the boron deposit; other substrates reacted to various extents. The hydrogen reduction of boron tribromide was briefly investigated. Boron carbide was deposited at 1,300°C by adding methane to the boron trichloride–hydrogen feed gas. The chemical composition of the vapor deposited boron carbide approximated B_4C. A method of etching B_4C was developed to study its microstructure. When boron was deposited on graphite at 1,500°C, very hard, uniform, strongly adherent coatings of B_4C were formed that might be useful in rocket nozzle applications. Author

N68-24787# Joint Publications Research Service, Washington, D. C.
THE SYNTHESIS AND COMPARATIVE EXPERIMENTAL AND THEORETICAL STUDY OF POLY-1,2,4- AND POLY-1,3,4-OXADIAZOLES [SINTEZ I SRAVNITEL'NOYE EKSPERIMENTAL'NOYE I TEORETICHESKOYE IZUCHENIYE POLI-1,2,4- I POLI-1,3,4-OKSADIAZOLOV]
D. A. Bochvar, I. V. Stankevich, Ye. S. Krongauz, A. L. Rusanov, and V. V. Korshak 22 May 1968 9 p refs Transl. into ENGLISH from Vysokomolekul. Soedin. (Moscow), v. 9(A), no. 7, 1967 p 1429–1434
(JPRS-45461) CFSTI: HC$3.00/MF$0.65

Poly-1,2,4- and poly-1,3,4-oxadiazoles were synthesized by the method of intramolecular polyheterocyclization from derivatives of oxalic acid and dichlorides of aromatic dicarboxylic acids. The poly-1,2,4 compounds were synthesized by the interaction of oxamidoxime with dichlorides of aromatic dicarboxylic acids in hexamethylphosphoramide. This yielded poly-O-acyloylamidoximes, which were vacuum heat treated to form the desired compounds. The poly-1,3,4 compounds were synthesized by the interaction of oxalic acid dihydrazide with the dichlorides, and this yielded polyhydrazides which were subjected to thermal dehydration. The poly-1,3,4 oxadiazoles had somewhat higher softening temperatures than analagous poly-1,2,4 oxadiazoles. The greater stability of the electron system in the former compound is due to greater stability of the pi-electron system of the isolated 1,3,4-oxadiazole ring as well as to higher conjugation energy. M.W.R.

N68-24832# Rocket Propulsion Establishment, Westcott (England).
A MASS SPECTROMETRIC STUDY OF THE THERMAL DECOMPOSITION OF PERCHLORIC ACID AND CHLORINE DIOXIDE
I. P. Fisher Nov. 1966 67 p refs
(RPE-TR-66/13) CFSTI: HC$3.00/MF$0.65

A commercial mass spectrometer has been modified to detect transient species in decompositions in the gas phase. Perchloric acid was observed to decompose mainly to ClO_2 and ClO. The ionization potentials of these species were obtained: $I(ClO_2) = 10.7 \pm 0.1$ eV and $I(ClO) = 11.1 \pm 1$ eV. As a result of similar studies on the decomposition of chlorine dioxide it is concluded that the ClO radical is derived from perchloric acid mainly by the reaction $HOClO_3 \rightarrow OH + O_2 + ClO$; ClO_2 is tentatively

proposed to arise from perchloric acid by the heterogeneous reaction $HOClO_3 \rightarrow HO + ClO_2$. Electron impact studies on ClO_2 enabled a value for the bond dissociation energy D(O–ClO) = 55 ± 2 kcal to be obtained. This value serves to confirm the value for the ionization potential I(ClO). It is suggested that ClO radicals play an important part in perchloric acid/fuel flames. Author

N68-24839# Commissariat a l'Energie Atomique, Saclay (France).
POTENTIOMETRIC TITRATION OF U(6) OR U(4) IN SOLUTION IN PHOSPHORIC ACID. DETERMINATION OF URANIUM OXIDE [TITRAGE POTENTIOMETRIQUE DE L'URANIUM 6 OU DE L'URANIUM 4 EN SOLUTION DANS L'ACIDE PHOSPHORIQUE. DOSAGE DE L'OXYDE D'URANIUM]
Fuminari Nakajima and Kaoru Sakai 15 Apr. 1966 26 p refs Transl. into FRENCH from Nippon Kagaku Zasshi (Tokyo), v. 85, 1964 p 40–44 In FRENCH
(CEA-TR-X-630) CFSTI: HC $3.00/MF $0.65

Methods for the potentiometric titration of U(VI) or U(IV) in a phosphoric acid solution were studied. For U(VI) the methods consisting of the reduction to U(IV) by Ti(III) and the subsequent titration of U(IV) by an excess of potassium bichromate was first examined. As a solution of Ti(III) it is easy to use a solution prepared by dissolving metallic Ti with heating in concentrated phosphoric acid, because it is stable, being hardly oxidized by the air. When the U, after reduction, is titrated by potassium bichromate the potential varies in two stages. If the temperature of the solution is high, the variation of the potential is slow in the vicinity of the first end point, that is to say the point where the excess of Ti(III) begins to be oxidized. If the solution is heated to 95°C the potential varies rapidly, which makes the end point sharp. The second end point is always sharp no matter what the temperature of the solution. For U(IV) the method consisting of titrating it directly by potassium bichromate was examined. If metallic U or U(IV) in a compound is attacked on heating by concentrated phosphoric acid, it dissolves quantitatively taking the form of tetravalent ions. If it is heated during titration, a dilute solution after dissolution in the concentrated phosphoric acid and a small fraction of the U(IV) is oxidized by the air. It is then better to do the titration at room temperature. By combination of these two methods it is possible to determine in a single series of operations U(IV) and U(VI) contained in a single sample. Author (NSA)

N68-24842 Akron Univ., Ohio.
SPECTRAL STUDIES OF ANIONIC POLYMERIZATION
William Bernard Brown (Ph.D. Thesis) 1966 201 p
Available from Univ. Microfilms: HC $9.25/MF $3.00 Order No. 67-2771

Several monofunctional organosodium compounds were prepared which were soluble in hydrocarbon solvents. Comparison of the viscosity of active and terminated polystyryl–sodium showed that the active polymers were associated in hydrocarbon solvent. Rates were determined for the organosodium polymerization of styrene in cyclohexane, at 40°C. The bimolecular rate constant k was determined to be about 57 liters mole $^{-1}$ min. $^{-1}$ Measurements of initiation rates of styrene with ethyllithium in benzene by ethane evolution from hydrolyzed solutions confirmed the 1/6th order in initiator. Quantitative measurements of the spectra of isoprenyllithium in the presence of ethyllithium in hexane showed that the absorption decreased in the presence of added ethyllithium. Evidence indicates this absorption to be due to the isoprenyllithium dimer. In the range of initiator concentration from 1×10^{-3} M to 5×10^{-6} M, the dependence of polymerization rates on anion concentration is one-half in hexane and one-fourth in cyclohexane. Dissert. Abstr.

N68-24853 Pennsylvania State Univ., University Park.
HYDROTHERMAL CRYSTAL GROWTH OF THE RUTILE STRUCTURE OXIDES TiO_2, GeO, AND SnO_2
Martin Lavell Harvill (Ph.D. Thesis) 1966 110 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-1928

Single crystals of three rutile-structure group IV oxides were grown hydrothermally up to 5mm in size. Growth conditions were 600–700°C, 4100 bars, and 80–100°C ΔT for TiO_2 in 9M H_2SO_4; 700°C, 4100 bars, and 100°C ΔT for SnO_2 in 2M KOH; 450–700°C, 1000–4100 bars, and 50–100°C ΔT for GeO_2 in H_2O. All crystals were prepared to 99.99 per cent cation purity, and total OH content as measured by infra-red absorption for TiO_2 was even less than flame fusion material. Dislocation densities of TiO_2 were far less than crystals prepared by other means. The potential of adding controlled amounts of impurities to TiO_2 was demonstrated. Both Ni and Sn increased the dislocation content of TiO_2 but Ge had no detectable effect. The solubility (S) of GeO_2 in H_2O was found to be a function of the density (ρ) of pure water at the experimental conditions according to the equation $S = k_1\rho + k_2\rho^2 + k_4\rho^4$ (where k's are constants). This may indicate that a species $GeO_2 \cdot nH_2O$ is formed, and n = 1 dominates at low densities (pressures); n = 2, intermediate densities; and n = 4 at high densities. However, the model is not unambiguous. Dissert. Abstr.

N68-24905 Maryland Univ., College Park.
THE ANALYSIS OF THE VIBRATIONAL BEHAVIOR OF BOUND POLAR COMPLEXES
Richard Dean Gilardi (Ph.D. Thesis) 1966 93 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-2005

The effects of association on the vibrational spectra of simple molecules have been theoretically examined. Attention has been concentrated on the nature of the intermolecular modes of motion which are expected in any bound association complex. The specific case of a dimeric dipole dipole system was examined quantitatively. A one dimensional calculation was described wherein the dimer made up of two molecules was treated as if it were a two atom system; i.e., a huge diatomic molecule. Recently reported far infrared intermolecular data were inserted into the framework of this calculation. As a result, simple parametric intermolecular potentials were characterized for several polar molecules. The dimerization bond energies and intermolecular separations predicted seemed reasonable, and were in fair agreement with similar results obtained from virial coefficient data. Dissert. Abstr.

N68-24930 State Univ. of Iowa, Iowa City.
STUDIES OF DONOR-ACCEPTOR COMPLEXES
Larry Marlin Julien (Ph.D. Thesis) 1966 320 p
Available from Univ. Microfilms: HC $14.40/MF $4.10 Order No. 67-2643

The ultraviolet charge transfer absorption bands of the iodine complexes with acetone, butyraldehyde, ethanol, iso-propyl ether and methanol have been studied. The thermodynamic and spectral properties were determined from temperature dependent studies of these charge transfer absorptions. It was found that the formation constants calculated for these systems varied as a function of wavelength. It is believed that contact charge transfer absorption was the major source of these changing iodine molar absorptivities. In addition, the changing nature of the dispersion properties of the solutions was also believed to be a source (although somewhat less important in most cases) of the above changes. The relationship between the donor ionization potentials and the frequency of the absorption bands is also discussed. It was found that the behavior of the systems of the iodine and oxygen containing donors were similar to the results found for the nitrogen containing donor-iodine systems. Dissert. Abstr.

N68-24933*# Institute of Modern Languages, Inc., Washington, D. C. Translation and Interpretation Div.
REACTION OF POTASSIUM PEROXIDE WITH CARBON DIOXIDE [O VZAIMODEYSTVII PEREKISI KALIYA S UGLEKISLYM GAZOM]

S. Z. Makarov and I. I. Vol'nov NASA Feb. 1968 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR (Moscow), no. 4, 1951 p 370–376
(Contract NASw-1693)
(NASA-TT-F-11478) CFSTI: HC $3.00/MF $0.65 CSCL 07B

A discussion is given of the final products produced by the reaction, with continuous determination of the phase composition during carbonation, as carried out under close to thermal conditions. The formation of K_2CO_4 from KO_2 is accelerated with rising temperature, but decomposition is also correspondingly accelerated.
Author

N68-24981*# Battelle Memorial Inst., Columbus, Ohio.
DEVELOPMENT OF CHEMICAL ANALYSIS TECHNIQUES FOR ADVANCED MATERIALS Quarterly Progress Report, 17 Jan.–16 Apr. 1968
E. R. Blosser 30 Apr. 1968 18 p Prepared for JPL
(Contracts NAS7-100; JPL-951578)
(NASA-CR-94793; QPR-4) CFSTI: HC $3.00/MF $0.65 CSCL 07D

The laser decomposition of magnesium oxide plus graphite was continued, and a new approach to determine hydroxyl was begun. Mass spectrographic studies were continued, emphasizing the analysis of refractory materials for elements other than the interstitial elements. A Knudsen cell run was made in an attempt to establish the time-temperature relationships in the magnesium oxide-graphite-hydroxyl system.
Author

N68-24982 Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
BASE STRENGTH OF VARIOUS ORGANIC OXIDES
C. Klofutar, F. Krasovec, and M. Kusar Feb. 1968 10 p refs Submitted for publication
(NIJS-R-518)

The protonation constants pK_a of various aromatic substituted organic oxides are reported. The following order of increasing basicities of the investigated organic oxides was established: sulphoxides, phosphine oxides, pyridine-N-oxides, selenoxides, arsine oxides, antimony oxides, and tellurium oxides. Several effects affecting the base strength of the investigated organic oxides, such as back donation, electronegativity of the element, its polarizability, and inductive effect of the radicals bound to the element are discussed.
Author

N68-25003 Pennsylvania State Univ., University Park.
ELECTRIC FIELD INDUCED INFRARED ABSORPTION SPECTRA OF HYDROGEN
John Vincent Foltz, Jr. (Ph.D. Thesis) 1966 76 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-1923

The electric field induced dipole spectrum and the stimulated Raman spectrum of molecular hydrogen have been investigated with spectroscopic instruments of high resolution. Frequencies of the five lines Q(0), Q(1), Q(2), Q(3), and S(1) of the 1-0 rotation–vibration band were measured over a range of pressures from 400 to 1100 psi. The frequency shifts due to pressure are represented as a power series in the gas density with linear and quadratic terms. Linear pressure shifting coefficients have been obtained for the five lines. Frequencies of the line Q(1) were measured at pressures extending up to 5600 psi. Both the linear pressure shifting coefficient a and the quadratic coefficient b have been determined for Q(1). They are: $a = -3.25 \times 10^{-3}$ cm $^{-1}$/Amagat and $b = 4.63 \times 10^{-6}$ cm $^{-1}$/Amagat ^{2}. The frequencies of all five lines were extrapolated to zero density and shown to agree well with line frequency measurements made on the quadrupole spectrum of hydrogen.
Dissert. Abstr.

N68-25017# Pennsylvania Univ., Philadelphia.
THE OXYGEN ELECTRODE: A MECHANISTIC STUDY
Marvin Alden Genshaw (Ph.D. Thesis) 1966 503 p
Available from Univ. Microfilms: HC $22.75/MF $6.40 Order No. 67-3070

The oxygen electrode reaction is one of the fundamental reactions involving water. The understanding of this reaction can provide a basis for the understanding of more complex electrode reactions. Therefore, this study of the mechanism of the oxygen electrode reaction, the nature of the substrate at which it occurs, and the nature of rest potentials, was undertaken. To elucidate the mechanism, various kinetic parameters, such as the Tafel slope, reaction order and pH dependence, were determined. The role of hydrogen peroxide as a reaction intermediate was investigated using a rotating disk electrode with a ring. The nature of the substrate was studied by combining coulometry and ellipsometry.
Dissert. Abstr.

N68-25019 Pennsylvania State Univ., University Park.
EQUILIBRIUM PHASE COMPOSITIONS AND THERMODYNAMIC PROPERTIES OF SOLID SOLUTIONS IN THE SYSTEM MgO–"FeO"–SiO_2
Ralph Hamilton Nafziger (Ph.D. Thesis) 1966 130 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-1945

Compositions of coexisting phases (oxide + olivine; olivine + pyroxene; olivine + SiO_2; olivine + pyroxene + SiO_2; pyroxene + SiO_2) in the system MgO–"FeO"–SiO_2 at low oxygen partial pressures and at subsolidus and solidus temperatures have been determined. The obtained data permit calculation of standard free-energies of formation of the olivine and pyroxene solid solution end-members and make possible the determination of their activities as a function of the compositions of the solid solution. These experimental data have important implications to some terrestrial rocks and meteorites, and can serve as a basis for studies in systems of a similar nature which find applications in technological processes. Three experimetnal procedures were used to determine compositions of the solid solutions: (1) X-ray lattice parameter measurements, (2) gas phase composition (P_{O_2}) in equilibrium with oxide and metallic phases, and (3) solidus temperature determinations.
Dissert. Abstr.

N68-25024 Pennsylvania State Univ., University Park.
FLUX GROWTH OF SINGLE CRYSTAL R_2O_3 OXIDES WITH THE CORUNDUM STRUCTURE
Ronald Edward Barks (Ph.D. Thesis) 1966 348 p
Available from Univ. Microfilms: HC $15.75/MF $4.45 Order No. 67-1909

Oxide crystals having the corundum structure, Fe_2O_3, Cr_2O_3 and Al_2O_3, have been grown from sodium, potassium and lead borate solutions. The relationship between various crystal growth parameters important in the flux method and their effect on the resulting crystals has been determined with respect to crystal properties. These include chemical analysis, etching techniques for dislocation studies, surface feature examination and weight fraction analysis to obtain the crystal size distribution. These properties have been related to the growth parameters in order to provide a concept of the growth process, and in order to evalu evaluate those factors to be considered in selecting the optimum combination of growth parameters and flux.
Dissert. Abstr.

N68-25032 California Inst. of Tech., Pasadena.
LIGAND BRIDGING IN THE OXIDATION OF CHROMIUM(2) AT MERCURY ELECTRODES
Janet Gretchen Jones (Ph.D. Thesis) 1967 174 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-192

Controlled potential electrolysis and electrochemical relaxation techniques have been used to investigate the mechanism of

oxidation of chromium(II) at mercury electrodes in the presence of chloride, bromide, and iodide. It is shown that the major path for the oxidation is through a bridged activated complex of the type Hg–X–Cr. Kinetic parameters have been determined for the bromide-dependent path and the halide-independent path. Equations have been derived to predict from kinetic data the product distribution between two competing reactions. It is suggested that the activated complex is formed with halide adsorbed on the electrode surface. The limitations of chronopotentiometry at hanging mercury drop electrodes have been investigated and corrections are given for spherical diffusion effects at times greater than 0.1 sec. It is demonstrated that reverse current chronopotentiometry under these conditions is a qualitatively unreliable technique.
Dissert. Abstr.

N68-25091# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
CHANGES IN URANIUM DIOXIDE SAMPLES AFTER CAN RUPTURE [EVOLUTION D'ECHANTILLONS DE BIOXYDE D'URANIUM APRES REPTURE DE GAINE]
Michel Guyonvarh and Roger Le Meur Nov. 1967 19 p In FRENCH
(CEA-R-3329)

UO_2 samples obtained from punctured cans were irradiated in the presence of CO_2 temperatures below 450°C. During irradiation, the detection of fission products indicated that an increase of the outside surface of the samples had occurred. After irradiation, examination showed an increase in volume together with a partial oxidation of UO_2 to U_3O_8. This evolution is attributed to the presence of free oxygen in the CO_2. This hypothesis is confirmed by heating a non-irradiated sample for 150 hours in air at 300°C. It is thus necessary to avoid the presence of air.
Author (NSA)

N68-25123 New York State Univ., Syracuse. Coll. of Forestry.
TRANSITION METAL CATALYSTS FOR POLYETHYLENE ENCAPSULATION OF SUBSTRATES
Henri Dominique Chanzy (Ph.D. Thesis) 1966 184 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-2755

The adsorption of a transition metal polymerization catalyst at the surface of a cellulose pulp may be achieved by adding successively $TiCl_4$ and $AlEt_3$ to a suspension of wood pulp in hydrocarbon or aromatic solvents. Addition of $TiCl_4$ gives a limited titanation of the pulp, governed by the amount of water present. Subsequent addition of $AlEt_3$ to the cellulose-$TiCl_4$ mixture results in a rapid precipitation of all the titanium at the cellulose surface. The precipitate of all the titanium is mainly in the form of $\beta TiCl_3$ which becomes the site of ethylene polymerization. The n-propanol, considered as a model of cellulose was reacted with $TiCl_4$ in solvents such as those used for encapsulation. When n-propanol was in excess, a compound such as $TiCl_2$-$(OC_3H_7)_2$.C_3H_7OH was the main product of the reaction while several other compounds and complexes were produced in minor quantities.
Dissert. Abstr.

N68-25138# California Univ., Livermore. Lawrence Radiation Lab.
REACTIONS OF COLUMBIUM AND VANADIUM WITH MAGNESIUM
E. C. Savitskii, V. V. Baron, Yu. V. Efimov, and M. I. Bykova Dec. 1966 8 p refs Transl. into ENGLISH from Tr. Inst. Met. im A. A. Baikova, Akad. Nauk SSSR (Moscow), no. 14, 1963 p 139–146
(UCRL-TRANS-10219) CFSTI: HC $3.00/MF $0.65

The solubility of Nb and V in liquid Mg was determined by the method of isothermal aging and subsequent quenching. It was found that Nb and V did not dissolve in solid Mg but that as liquid Mg was heated at 660 to 950°C, the solubility of V increased from 0.06 to 0.3%. At 1200°C the solubility of Nb in Mg was 0.05%. On remelting with Mg, Nb and V were deoxidized, and hardness, microhardness, and tensile strength decreased while plasticity increased. However, V was not completely free from O_2 after remelting with Mg six times. Phase diagrams for the Mg–Nb and Mg–V systems, based on X-ray and thermal studies of macrostructure and microstructure, and on hardness changes in the alloys are shown. The nature of the liquidus curve and the position of the solidus curve on the Mg sides of the system point to a pseudo–eutectic melting pattern.
NSA

N68-25141# Thiokol Chemical Corp., Denville, N. J. Reaction Motors Div.
SYNTHESIS OF POLYAMMONIUM BOROHYDRIDE SALTS, 30 SEPTEMBER 1966–29 SEPTEMBER 1967
Robert A. Falk 27 Oct. 1967 22 p refs Prepared for Calif. Univ., Lawrence Radiation Lab.
(Contract W-7405-ENG-48)
(RMD-5097-F; UCRL-13320) CFSTI: HC $3.00/MF $0.65

Several poly(quaternary ammonium)borohydride salts having a high volume percentage of hydrogen and boron were prepared. These polymeric salts are of interest as neutron moderators and samples were submitted for evaluation by LRL. The salts were prepared from quaternized polyethylenimine of molecular weight 60,000 and 100,000. A number of unsuccessful experiments to prepare a bicyclic quaternary polymer are described. Finally, a dense bicyclic quaternary salt was prepared from pyrazino [2, 3-b] pyrazine, namely octamethylpyrazino [2, 3-b] pyrazinium dodecahydrododecaborate.
Author (NSA)

N68-25142# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
FIXATION AND SEPARATION OF ELEMENTS THORIUM AND URANIUM BY ION EXCHANGE RESINS IN NITRATE SOLUTIONS [FIXATION ET SEPARATION DES ELEMENTS THORIUM ET URANIUM PAR LES RESINES ECHANGEUSES D'ANIONS EN MILIEU NITRATE]
Vasant Korgaonkar (Ph.D. Thesis—Paris Univ.) Oct. 1967 61 p refs In FRENCH
(CEA-R-3222)

The exchange of thorium and uranium between a strong base anion resin and a mixed water + ethanol solvent containing nitrate ions was studied. It was assumed that in the resin the thorium and uranium are fixed in the form of the complexes $Th(NO_3)_6^{2-}$ and $UO_2(NO_3)_4^{2-}$; in solution these elements are present in the form of complexes having the general formulas: $Th(NO_3)_{6-n}^{n-2}$ and $UO_2(NO_3)_{4-n}^{n-2}$. It was possible to deduce a law for the changes in the partition functions of thorium and uranium as a function of the concentrations of the various species in solution and of the complexing ion NO_3. From this was deduced the optimum operational conditions for separating a mixture of these two elements. Under these conditions, the influence of the following interfering ions was studied: Ba, Bi, Ce, La, Mo, Pb, and Zr. The method proposed can be used either as a preparation, or for the determination of thorium by a quantitative separation.
Author (NSA)

N68-25153# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
CHEMICAL AND ISOTOPIC ANALYSIS OF BORON IN URANIUM BY MASS SPECTROMETRY [ANALYSE CHIMIQUE ET ISOTOPIQUE DU BORE DANS L'URANIUM PAR SPECTROMETRIE DE MASSE]
Jean Chenouard and Guy Niof Nov. 1967 14 p refs In FRENCH
(CEA-R-3219)

A method is described for the determination by mass spectrometry of the concentration and the isotopic composition of small quantities of boron in uranium. The concentration range is between 10 and 100 ppM. The boron is extracted by distillation of methyl borate. The concentration is determined by isotopic

dilution. Many precautions have to be taken to limit and correct contaminations. This method of analysis is applicable for at least 0.2 μg of boron; the relative accuracy is about 2%. Author (NSA)

N68-25180# Oak Ridge National Lab., Tenn. Chemical Technology Div.
RELATIONSHIP BETWEEN HOLDUP AND FLOODING IN A PULSED, SIEVE PLATE EXTRACTION COLUMN
Richard James Mc Namee (M.S. Thesis—Tenn. Univ., Knoxville) Mar. 1968 110 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1229) CFSTI: HC $3.00/MF $0.65

A method for determining the flooding rate of a pulsed, sieve-plate solvent-extraction column was developed. This method is based on measurement of the dispersed phase holdup as a function of throughput rate and time. Since it is a quantitative technique, the error introduced through the judgment of the observer required in the conventional visual method of determination is eliminated, and less experimental work is required. The basic mathematical model used to describe holdup is $(V_D/x) + \overline{V}_C/1-x) = \overline{V}_0 (1-x)$, where x is the fractional volume holdup of the dispersed phase, V_C and V_D are the superficial velocities through the column of the continuous and dispersed phases, respectively, and V_0 is a characteristic velocity. Holdup was nearly a linear function of throughput, and the holdup at which flooding begins, actually only 0.4 of the holdup corresponding to maximum flow throughput, as predicted by the model, is independent of pulse frequency. The logarithms of the flow rate at flooding and V_0 were decreasing linear functions of increasing pulse frequency. Author (NSA)

N68-25218# United Kingdom Atomic Energy Authority, Harwell (England).
USE OF γ EXCITED X-RAY LUMINESCENCE TO DETERMINE LEAD CONTENT IN MULTI-METAL ORES
L. I. Shmonin, M. B. Enker, E. V. Mager, and V. F. Ostapenko Jun. 1967 8 p refs Transl. into ENGLISH from Nekotorye Vopr. Obshch. Prikl. Fiziki (Alma-Ata), 1965 p 173–175
(CONF-651090-1) CFSTI: HC $3.00/MF $0.65

The possibility of devising a method using gamma-excited X-ray luminescence for determining the lead content of ores with considerable admixtures of barium was studied. Selenium-75 was used as the gamma source. A method using two spectral ratios gave a sensitivity of approximately 0.2% lead. NSA

N68-25253# Kernforschungszentrum, Karlsruhe (West Germany).
OXIDATION OF PLUTONIUM (4) TO PLUTONIUM (6) USING MANGANESE DIOXIDE
H. Vogg Mar. 1967 13 p refs Transl. into ENGLISH from German Sponsored by the US/EURATOM Fast Reactor Exchange Program
(EURFNR-417; KFK-621; EUR-3690.D) CFSTI: HC $3.00/MF $0.65

Manganese dioxide prepared by acid reactions with potassium permanganate at 60 to 70°C with the addition of Cr–Ni steel swarf can oxidize plutonium(IV) to plutonium(VI) in a nitric acid medium. The best method for total oxidation is a manganese dioxide column; quantitative recovery of the plutonium from the column is guaranteed at a minimum nitric acid concentration of 2N and a minimum temperature of 30°C. Author (NSA)

N68-25300 Utah Univ., Salt Lake City.
KINETICS OF REDUCTION OF CUPROUS OXIDE TO COPPER IN HYDROGEN AND HYDROGEN-WATER VAPOR MIXTURES
Stephen Charles Thayer (Ph.D. Thesis) 1967 123 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-3227

Samples of cuprous oxide were formed by oxidizing one half inch square plates of high purity copper in air at 1040°C. These samples were reduced in hydrogen and hydrogen-water vapor atmospheres in the temperature range of 200°C to 400°C. The kinetics of reduction were noted by the change in weight of the samples with time using a calibrated quartz spring balance. Samples of cuprous oxide containing various mole ratios of cuprous oxide to nickel oxide, were oxidized from copper-nickel alloys. The mole ratios, cuprous oxide to nickel oxide, were 10:1, 100:1 and 1000:1. These are referred to as 9%, 1% and 0.1% NiO respectively. These samples as well as pure cuprous oxide samples were reduced in hydrogen-water vapor atmospheres at temperatures of 260°C, 300°C, 340°C and 400°C. This effort was intended to show that additions of nickel oxide decreased the rates of reduction of cuprous oxide by decreasing the electron hole concentration of the oxide and thus decreasing the amount of hydrogen adsorbed on the surface of cuprous oxide at a given hydrogen partial pressure. Dissert. Abstr.

N68-25303# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
ABSOLUTE QUANTITATIVE ANALYSIS OF HIGH CONCENTRATIONS BY HIGH-FREQUENCY SPARK-SOURCE MASS SPECTROGRAPHY. APPLICATION TO AN 18/10 STAINLESS STEEL [ANALYSE QUANTITATIVE ABSOLUE DES FORTES TENEURS PAR SPECTROGRAPHIE DE MASSE A ETINCELLES HAUTE-FREQUENCE. APPLICATION A L'ACIER INOXYDABLE 18/10]
George Vidal, Pierre Galmard, and Pierre Lanusse 1968 27 p refs In FRENCH; ENGLISH summary
(ONERA-NT-125) CFSTI: HC $3.00/MF $0.65

After mentioning particular cases when high concentration analysis by means of spark-source mass spectrography may be useful, the general formulas to be adopted for this type of analysis are determined, taking into account the various corrections which have to be made. By means of a spectrograph, these formulas are applied to the determination of the abundance of the isotopes of cadmium and to the absolute quantitative analysis of a 18% Cr–10% Ni stainless steel alloy. In this latter case, the coefficient of variation is 16% and, when compared to the results given by chemical analysis, the mean values found for five measurements differ only by 6% of the true values when, for each constituting element, a coefficient of sensitivity is introduced. This coefficient is calculated from certain physical characteristics of the element. Author

N68-25356 Missouri Univ., Columbia.
ABSORPTIOMETRIC INVESTIGATIONS OF THE ANALYTICAL UTILITY OF HAFNIUM AND ZIRCONIUM HETEROPOLY MOLYBDATES
Churby Conrad Clowers, Jr. (Ph.D. Thesis) 1966 109 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-2850

No mixed heteropoly compounds containing either hafnium or zirconium have ever been isolated. Few studies have been made on the solution chemistry of their presumed simple heteropoly molybdates. It was found that only their ternary (mixed) species have desirable chromogenic properties. Thus, a convenient means was available for investigating their analytical utility, as well as their means of formation. Spectrophotometric methods were developed for the determination of hafnium using two distinctly different ligands: a sulfatomolybdate(I) species and a molybdophosphoric acid(II) species. The first method is based on the reaction of Hf(IV) with (I) at pH 1.3 in sulfate medium at 45°C. The reaction product yields a deep blue hue upon reduction with Sn^{+2} in acid solution, whose intensity increases with hafnium concentration. The second method is based on the reaction of Hf(IV) with (II), buffered at pH 4.0 in acetate medium, to yield a product reducible to a different blue hue from that with (I). Conditions surrounding the use of

ligand (I) for hafnium determination were applied to an analogous system containing zirconium. This application results in a marked increase in sensitivity and selectivity when modified. Dissert. Abstr.

N68-25440# Melon Inst., Pittsburgh, Pa. Radiation Research Labs.
[ON RADIATION RESEARCH] Quarterly Report, 1 Oct.–31 Dec. 1967
24 Jan. 1967 15 p refs *Its* Fundamental Res. No. 6041
(Contract AT(30-1)-2310)
(RRL-2310-223) CFSTI: HC $3.00/MF $0.65

Research progress is reported on: electron decay in pulse-irradiated gases, pulse radiolytic studies of ions in organic media, solvated electrons spectra in viscous alkaline aqueous solutions, electron scavenging in irradiated cyclohexane solutions, effect of electron scavengers on the reaction of the cyclohexane positive ion with cyclopropane, mass-spectrometric investigations of the $N_2 + CH_4$ discharge flow systems, intermediates in nucleophilic aromatic substitutions, and radioinduced hydroxylation of fluorobenzene in dilute aqueous solutions. NSA

N68-25520# Bettis Atomic Power Lab., West Mifflin, Pa.
DETERMINATION OF THE SOLUBILITY AND DIFFUSION COEFFICIENT OF HYDROGEN IN ZIRCONIUM
Mayumi Someno [1967] 16 p refs Transl. into ENGLISH from Nippon Kinzoku Gakkaishi (Sendai), v. 24, 1960 p 249–253
(WAPD-TRANS-86) CFSTI: HC $3.00/MF $0.65

The solubility of H in Zr was determined using absorption isotherms, and the diffusion coefficients of H in alpha and beta Zr were determined by the method of diffusion annealing. Methods of sample preparation, equipment and procedures used in the investigation are described and discussed. Absorption isothermals for H at 500 to 950°C are shown, as are curves indicating solubility of H in alpha and beta Zr, and equations for determination of the diffusion coefficients. NSA

N68-25581# Oak Ridge National Lab., Tenn.
UNIT OPERATIONS SECTION Quarterly Progress Report, Jul.–Sep. 1966
M. E. Whatley, P. A. Haas, L. E. Mc Neese, A. D. Ryon, J. C. Suddath et al Feb. 1968 68 p refs
(Contract W-7405-ENG-26)
(ORNL-4075)

This report contains six articles dealing with the following: (1) performance data of scale and full-scale versions of a stacked-clone solvent extraction contactor; (2) stability data of quaternary amine-diatomaceous earth packings used in the chromatographic separation of transfer ribonucleic acids when in contact with eluting sodium chloride solutions; (3) progress in the development of grind-leach processing of unirradiated fuels of the graphite-matrix type; (4) progress in the preparation of uranía sol and in the formation of uranía or mixed oxide sols into microspheres; (5) development of equipment and procedures for the preparation of oxide microspheres in a shielded facility, and the preparation of thoria microspheres for fuel cycle studies; and (6) preliminary experiments in a recirculating equilibrium still to determine the relative volatilities of rare earth trifluorides. K.W.

N68-25607# Mound Lab., Miamisburg, Ohio.
SEPARATION OF AR 36 BY THERMAL DIFFUSION
J. Casas, M. Quintanilla, J. M. Saviron, and J. A. Madariaga 23 Feb. 1968 16 p refs Transl. into ENGLISH from Anales de Fis. y Quim. (Madrid), Ser. A, v. 63, 1967 p 91–98
(Contract AT(33-1)-GEN-53)
(MLM-1483(TR)) CFSTI: HC $3.00/MF $0.65

The separation of ^{36}Ar was measured in an installation having seven columns in series and a reservoir of 50 l at one end. The results obtained were compared with the experimental results. Good agreement was found between theory and experimental results. NSA

N68-25612# Joint Publications Research Service, Washington, D. C.
SOVIET STUDIES IN ANALYSIS OF ORGANOPHOSPHORUS COMPOUNDS AND SEPARATION OF U(IV) AND U(VI) IONS
22 May 1968 15 p refs Transl. into ENGLISH from Zh. Analit. Khimii (Moscow), v. 23, Mar. 1968 p 407–410, 455–457, and 468–470
(JPRS-45458) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. ELEMENTAL ANALYSIS OF UNSTABLE ORGANOPHOSPHORUS COMPOUNDS. SELENIUM USED AS A DESENSITIZER A. P. Terent'yev et al p 1–5 refs (See N68-25613 12-06)
2. SEPARATION OF URANIUM(VI) AND URANIUM(IV) IN SULFO-CATION EXCHANGERS CONTAINING VARIOUS AMOUNTS OF DIVINYL BENZENE Z. K. Karalova et al p 6–10 refs (See N68-25614 14-06)
3. SPECTROPHOTOMETRIC TRACE DETERMINATION OF PHOSPHORUS IN ORGANOELEMENTAL COMPOUNDS T. M. Shanina et al p 11–14 refs (See N68-25615 14-06)

N68-25613# Joint Publications Research Service, Washington, D. C.
ELEMENTAL ANALYSIS OF UNSTABLE ORGANOPHOSPHORUS COMPOUNDS. SELENIUM USED AS A DESENSITIZER
A. P. Terent'yev et al *In its* Sov. Studies in Analysis of Organophosphorus Compounds and Separation of U(IV) and U(VI) Ions 22 May 1968 p 1–5 refs (See N68-25612 14-06)

A method was formulated for analyzing unstable organophosphorus compounds by chemical desensitization using selenium followed by gravimetric determination of C, H, O, and Se content. Previously sulfur had been used as the stabilizing agent, but it lead to a sizable temperature increase; the selenium adds on to the organic compounds more vigorously, but does not result in this sizable temperature increase. Selenium, however, is not a universal desensitizer; and it has not given positive results when used with organiantimony compounds or chlorine-containing organophosphorus compounds. M.W.R.

N68-25614# Joint Publications Research Service, Washington, D. C.
SEPARATION OF URANIUM(VI) AND URANIUM(IV) IN SULFO-CATION EXCHANGERS CONTAINING VARIOUS AMOUNTS OF DIVINYL BENZENE
Z. K. Karalova et al *In its* Sov. Studies in Analysis of Organophosphorus Compounds and Separation of U(IV) and U(VI) Ions 22 May 1968 p 6–10 refs (See N68-25612 14-06)

It was shown that uranium (VI) and uranium (IV) could be separated in sulfuric acid solutions on resins with divinylbenzene content of more than 14%. A displacement method was used to establish the main indices of chromatographic separation of ions on various types of KU-2 sorbents, which are polymerization type sulfo-cation exchangers in the hydrogen form. M.W.R.

N68-25615# Joint Publications Research Service, Washington, D. C.
SPECTROPHOTOMETRIC TRACE DETERMINATION OF PHOSPHORUS IN ORGANOELEMENTAL COMPOUNDS
T. M. Shanina et al *In its* Sov. Studies in Analysis of Organophosphorus Compounds and Separation of U(IV) and U(VI) Ions 22 May 1968 p 11–14 refs (See N68-25612 14-06)

Spectrophotometric determinations were made of phosphorus in the presence of heteroelemental organic compounds, and a study was made of the applicability of various methods of mineralization for such compounds. More than 800 organoelemental compounds were analyzed, and flask combustion was found to be useful for a wide variety of the compounds. Kjeldahl-type decomposition with concentrated H_2SO_4 plus HNO_3 or 70% $HClO_4$ was used for compounds that were not amenable to flask combustion. M.W.R.

N68-25645# Institutt for Atomenergi, Kjeller (Norway).
DETERMINATION OF SOME LANTHANIDE ELEMENTS IN APATITES BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS
E. Steinnes Oct. 1967 23 p refs
(KR-120)

The content of lanthanum, samarium, europium, and dysprosium in six apatites of various localities was determined by neutron activation and gamma spectrometry. The gamma activity measurements were performed by means of a sodium iodide detector, and were based on the complex X-ray peak at about 40 keV for Sm, Eu, and Dy, and on the 1590-keV photopeak for La. The results obtained are probably accurate to ±10% or better. In some of the samples the relative abundance of europium, compared to that of the other lanthanides, appears to be significantly low. Author (NSA)

N68-25652# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
TESTS OF BORAZINE AND BORAZOLE DERIVATIVES AS SCINTILLATORS FOR SLOW NEUTRONS [ENSAYOS DE DERIVADOS DE BORAZINA Y BORAZARENOS COMO CENTELLADORES PARA NEUTRONES LENTOS]
M. A. Molinari, A. E. Rojo, and G. J. Videla 1967 20 p refs In SPANISH
(CNEA-208) CFSTI: HC $3.00/MF $0.65

Tests were made of N-trimethyl, B-triphenyl, N-triphenyl B-tridiphenyl, N-triphenyl B-trinaphtyl borazines, and hydroxy-boraaza phenanthrene and bis 2-1 boraaza 2-naphthyl ether in benzene solution and as thin solid layers to count thermal neutrons from the reaction $Li^7(d, n)Be^8$ moderated with paraffin in the presence of a gamma source due principally to the reaction $Li^7(p, gamma)Be^8$. Absolute flux measurements were made of the neutrons and the gamma radiation using activation of indium layers and gamma spectrometry. Characteristic curves of the count and efficiencies were obtained with various scintillators. Studies were also made on the effect of the concentration, dimensions, etc., using Po–Be and Ra–Be sources as well as various gamma sources. Critical preparations were also tested, based on previous comparisons, with excellent results. Transl. by R.N.A.

07 COMMUNICATIONS

Includes communications equipment and techniques, noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N68-24357 Manufacture Belge de Lampes et de Materiel Electronique, Brussels (Belgium).
PHENOMENA LINK TO THE POLARIZATION OF ELECTROMAGNETIC RADIATION [PHENOMENES LIES A LA POLARISATION DU RAYONNEMENT ELECTROMAGNETIQUE]
M. Wirtz [1966] 14 p In FRENCH *Its* MBLE Rev., Vol. 9, No. 1

The duality between elliptic polarization and complex vectors is discussed, and the peculiarities of the reception of an elliptically polarized wave by an elliptically polarized antenna are examined. The decomposition in circular components permitted a clear visualization of the amplitude and phase variations as functions of the relative orientations of the two elliptic polarizations. These theories are then applied to the problem of interferometry. It is shown that without particular precautions the measurements can be influenced by important errors. Transl. by M.G.J.

N68-24358 Manufacture Belge de Lampes et de Materiel Electronique, Brussels (Belgium).
AUTOMATIC TRACKING SYSTEM: COMPUTATION ERRORS. CORRECTION METHODS [LE SYSTEME DE POURSUITE AUTOMATIQUE CALCUL DES ERREURS—METHODES DE CORRECTION]
J. C. Lienard and N. Wirtz [1966] 14 p refs In FRENCH *Its* MBLE Rev., Vol. 9, No. 1

Details are given on the master antenna which effectively tracked the third stage of the ELDO rocket by orientation of the different antennas. Particular attention is given to the angular precision required for that antenna, resulting from a supplementary function which casts doubt on the interferometric measurements. The principal adopted for the enslavement is that of comparing the amplitudes of signals captured by four identical primary illuminators placed in the focal plane of a unique parabolic reflector. To clarify the important parameters of such a device, a simple example of a system with one degree of freedom was used. Consideration is also given to an actual system with two degrees of freedom, in which the principal causes of error affecting tracking precision were studied successively. It was determined that the phenomena is apparently related to the nature of the radiation elements and of the incident wave (polarization), and to the requirement for high frequency circuits for comparing the captured signals.
Transl. by M.G.J.

N68-24462# General Electric Co., Syracuse, N. Y. Electronics Lab.
BANDWIDTH ENHANCEMENT OF SMALL SCATTERERS BY MEANS OF PASSIVE LOADING
D. A. Priebe and C. E. Nelson Jun. 1967 54 p refs
(R67ELS-54)

A small resonant antenna can be used as a scatterer having a radar cross-section much larger than its physical size. Although the gain-bandwidth product of such a device is invariant under resistive loading, the use of a passive multipole loading network can increase both the gain-bandwidth product and the absolute bandwidth at any given cross-section level. First and second order theoretical limits are derived for the maximum bandwidth enhancement factor as a function of allowed center frequency cross-section degradation for the case of infinite circuit complexity. Design procedures are outlined for the synthesis of loading networks of finite complexity, involving a numerical method of optimally fitting the modified scattering response to some desired curve. The cases of maximally flat and maximized bandwidth designs are discussed, and computed results presented. These results indicate that the theoretical limit of bandwidth enhancement is approached by the use of loading circuits of practical complexity. Author

N68-24501# General Electric Co., Schenectady, N. Y. Research and Development Center.
INDEPENDENT SURVEILLANCE AND COMMUNICATION USING SATELLITES
R. E. Anderson Aug. 1967 41 p refs
(Rept.-67-C-316)

A postulated system uses satellites and cooperating ground stations to provide independent surveillance of the positions of aircraft and ships, and also undelayed voice and digital communication. The

system employs a low energy speech transmission technique that requires only a fraction of the energy needed for FM or conventional AM transmissions, so that a small satellite can provide an operationally useful number of channels with good performance margins. Position fixes are made by pulse train ranging from pairs of satellites. Accuracy is adequate for air traffic control at VHF frequencies. One nautical mile accuracy can be provided at higher frequencies, and 0.1 nautical mile accuracy may be achieved eventually. The techniques have been demonstrated sufficiently to show that no technological breakthroughs are needed, and a system could be operational before 1970. Author

N68-24517# General Electric Co., Syracuse, N. Y. Electronics Lab.
RANK CORRELATION
F. H. Schlereth and J. M. Irwin Jun. 1967 42 p ref
(R67ELS-55)

The Spearman r_S rank correlation coefficient and the Mann–Whitney U statistic are considered with respect to the problems associated with the implementation of special purpose electronic computers for the computation of these statistics. Computing algorithms designed to minimize equipment complexity are described in detail. Also included are detailed circuit diagrams and block diagrams showing how each of the required computations could be realized. A design example indicates that with the use of off-the-shelf digital and analog integrated circuits it is possible to compute r_S for two 32-component input signals in less than 10 millisec, on a continuous basis. Author

N68-24573*# Illinois Univ., Urbana. Biological Computer Lab.
INFORMATION TRANSFER IN COMPLEX SYSTEMS, WITH APPLICATIONS TO REGULATION
Roger C. Conant Jan. 1968 206 p refs
(Grants NGR-14-005-111; AF-AFOSR-7-67; Contract AF 33(615)-3890)
(NASA-CR-94698; TR-13) CFSTI: HC $3.00/MF $0.65 CSCL 09D

This study is concerned with information theory and its relevance to the study of complex systems. It is shown here that multivariable information theory is capable of eliminating much detail while preserving information about the interrelations between parts of a system, even when those interrelations are very complex. A procedure is described and exemplified, for example, which is helpful in the decomposition of hierarchical systems. It is shown, among other results, that when two variables are related in the set theoretic sense, the transmission between them is maximized when their behaviors are isomorphic. This observation leads to an algorithm for the computation of channel capacity for arbitrary finite-state systems of a very general type. The importance of information in regulatory processes is discussed and quantified, and several basic regulatory schemes are discussed in terms of the information involved, showing in an exact way how information transfer and channel capacity limit the ability of any system to act as a successful regulator. Author

N68-24663* Houston Univ., Tex. Dept. of Electrical Engineering.
DOPPLER RETURN FROM A RANDOM ROUGH SURFACE
R. F. Broderick and H. S. Hayre May 1968 31 p
(Contract NAS9-7828)
(NASA-CR-92134; TR-68-7) CFSTI: $3.00 CSCL 17I

A theoretical analysis of the doppler return from a random rough surface shows that the doppler spectrum is composed of three distinct components. The methods of analysis for determining the average power return for the static case and an application of the ergodic hypothesis for a stationary surface shows that the assumption of a single doppler component is based on the smooth surface. In addition to this coherent component, the incoherent components of the random rough surface produce two additional frequency components. The amplitudes of these latter components depend on the variance of the surface and the antenna beamwidth averaging. Radar measurements were made utilizing a scatterometer in order to measure the surface characteristics. Simultaneous measurements from a doppler radar system were analysed to identify the additional frequency components. Author

N68-24671*# Texas Univ., Austin. Defense Research Lab.
EFFECT OF SIGNAL DURATION ON DETECTION FOR GATED AND FOR CONTINUOUS NOISE
Ann Tucker, Paul I. Williams, and Lloyd A. Jeffress [1968] 17 p refs
(NASA Order R-129; Contracts Nonr-3579(04); N00024-68-C-1117)
(NASA-CR-94734) CFSTI: HC $3.00/MF $0.65 CSCL 09D

A series of two-alternative, forced-choice experiments showed that for short durations, the detection of a tonal signal in noise when the two are gated synchronously is superior to the detection of the signal in a background of continuous noise. The experiments also showed that for gated signal and noise, there is a steady improvement in detection as the duration is shortened, provided that highly-practiced observers are employed in the task. Naive observers exhibit a similar trend but their performance drops at the short durations (5 and 10 msec) where the listening task becomes very difficult. Author

N68-24686# Standard Electrik Lorenz A. G., Stuttgart (West Germany).
CALCULATION OF ERROR PROBABILITY WITH GROUP SYNCHRONIZATION [BERECHNUNG DER FEHLERWAHRSCHEINLICHKEIT BEI DER BLOCKSYNCHRONISATION]
D. Schaffar Mar. 1968 24 p refs In GERMAN; ENGLISH summary
(BMWF-FB-W-68-22) CFSTI: HC $3.00/MF $0.65

In data transmission systems using the start–stop principle of operation, two types of errors can occur due to synchronization faults: missing synchronization results in loss of information, wrong synchronization may result in the transmission of false information. It is the aim of this study to calculate the probability of occurrence of these errors, an important part of it dealing with the probability of a given signal sequence appearing at least once in a stochastic pulse sequence of finite length. Author

N68-24762# Standard Electrik Lorenz A. G., Stuttgart (West Germany).
INVESTIGATION OF BIT SYNCHRONIZATION METHODS FOR DATA TRANSMISSION OVER NOISY CHANNELS [UNTERSUCHUNG VON TAKTSYNCHRONISATIONSMETHODEN BEI DATENUEBERTRAGUNG AUF GESTOERTEN KANAELEN]
W. Kaehler Bad Godesberg, West Ger. Bundesmin. fuer wiss. Forsch. Mar. 1968 45 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-68-28) CFSTI: HC $3.00/MF $0.65

This study deals with the problems of bit synchronization. Two solutions are described: the pulling of a tuning-fork oscillator, and a purely digital method in which synchronization is achieved by corresponding setting of the division ratio of a counter. Special emphasis has been given to the description of the lock-in and transient behavior of the phase-locked tuning-fork oscillator. The digital system uses pulling of the synchronization phase by advancing or putting back the reset point of a counter. As counter a feedback shift register is used. Author

N68-24807# Standard Electrik Lorenz A. G., Stuttgart (West Germany).
CRITICAL ANALYSIS OF DATA CHANNELS WITH INFORMATION FEEDBACK [KRITISCHE BEWERTUNG VON DATENU-

EBERTRAGUNGSKANAELEN MIT INFORMATIONSRUECK-KOPPLUNG]
D. Schaffer Mar. 1968 28 p refs In GERMAN; ENGLISH summary
(BMWF-FB-W-68-21) CFSTI: HC $3.00/MF $0.65

The capacity of a data channel with information feedback is compared to the capacity of a similar channel without information feedback. The report bases on three papers of W. B. Bishop and B. L. Buchanan, C. E. Shannon, and S. S. L. Chang. The above authors try to prove that it is not possible to increase the channel capacity by the introduction of information feedback. The reasoning of the authors is critically analysed in this study. In an annex the basic principles of information theory are summarized. Author

N68-24845*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
AN INTEGRATED-CIRCUIT DIRECT-COUPLED AMPLIFIER FOR SPACECRAFT USE
Guss E. Wenzel Washington May 1968 72 p refs
(NASA-TN-D-4584) CFSTI: HC $3.00/MF $0.65 CSCL 09F

The integrated-circuit direct-coupled differential-amplifier design is based on a previous phase of development and has advanced the state-of-the-art of direct-coupled amplifiers to the extent that the stability and drift characteristics are equal to, or superior to, the conventional high performance chopper direct current amplifier. The circuit diagrams and the physical layout of the various components are presented. The amplifier performance, when powered from a typical flight battery, is described by various tables and plots of test data. Author

N68-24907 Maryland Univ., College Park.
DATA COMPRESSION WITH ERROR-CONTROL CODING FOR SPACE TELEMETRY
Thomas Joseph Lynch (Ph.D. Thesis) 1966 130 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-2337

The considerations involved in the combination of data compression and error control coding in space telemetry are analyzed through the use of two performance measures, D and R, which are similar to those used by Shannon for his *rate distortion function*. The average distortion D, is a function of the source probability distribution, the overall system transitional probability matrix, and a cost matrix which signifies the relative importance of different types of data errors. The rate-ratio, R, is the reciprocal of the overall system compression ratio and includes the data expansion effect of timing and identification data as well as coding redundancy. Different schemes for supplying the timing information in a compressed system are analyzed and compared. A new timing scheme is developed which requires on the average fewer time words for a large class of data sources. A method is developed for uniquely encoding and decoding an entire sequence of time words for compressed data, utilizing the strict monotonicity of the sequence. Dissert. Abstr.

N68-24919*# Boeing Co., Seattle, Wash. Launch Systems Branch.
PROTOTYPE 20 WATT SOLID-STATE TELEMETRY TRANSMITTER, VOLUME 1 Final Technical Report
W. Ledrew and J. Dettmann 1 Apr. 1968 38 p
(Contract NAS8-20777)
(NASA-CR-61767; D5-13424, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 09F

A summary of the design goals and requirements for the development of a prototype 20 watt solid state ultra high frequency telemetry transmitter is given. Included are graphs and plots of test program results as well as conclusions and recommendations for further studies. G.G.

N68-24969# Royal Aircraft Establishment, Farnborough (England).
A RECEIVER TO TRACK A PHASE MODULATED VERY LOW FREQUENCY CARRIER
R. Couzens Oct. 1967 50 p ref
(RAE-TR-67258) CFSTI: HC $3.00/MF $0.65

A receiver is described which is capable of phase tracking a VLF carrier, and its associated phase modulation sidebands. The changes in these phases are available as analogue outputs. The receiver is able to track, with zero velocity lag, the signals in a high speed aircraft. A typical trials result is shown and compared with theory. Suggestions for improvements in later receivers are made. Author

N68-24991*# Boeing Co., Seattle, Wash. Space Div.
PROTOTYPE 20 WATT SOLID STATE TELEMETRY TRANSMITTER, VOLUME 3
W. Ledrew and J. Dettmann 1 Apr. 1968 42 p
(Contract NAS8-21777)
(NASA-CR-94657; D5-13424, V. 3) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Presented are operating and maintenance procedures for a 20 watt, solid state telemetry transmitter. Its theory of operation contains schematics and block diagrams, photographs of the major components, tuning instructions, etc. G.G.

N68-24992*# Boeing Co., Seattle, Wash. Space Div.
PROTOTYPE 20 WATT SOLID STATE TELEMETRY TRANSMITTER, VOLUME 2
W. Ledrew and J. Dettman 1 Apr. 1968 42 p
(Contract NAS8-20777)
(NASA-CR-94671; D5-13424, V. 2) CFSTI: $3.00 CSCL 09F

Described are the procedures for performance and environmental testing of a 20 watt telemetry transmitter. Test data sheets and test equipment lists are included. G.G.

N68-25025 Michigan Univ., Ann Arbor.
DESIGN OF SIGNALS -TO ACHIEVE MINIMUM AMPLITUDE VARIATIONS
Donald Ralph Rothschild (Ph.D. Thesis) 1966 237 p
Available from Univ. Microfilms: HC $10.80/MF $3.10 Order No. 67-1795

The problem investigated is the minimizing of the ratio of peak power to average power of a bandlimited radio frequency signal by proper selection of the phase spectrum. This signal which has a prescribed power spectrum, is composed of a multiplex of N equally spaced frequency components, so that its envelope is periodic. Since incoherent phasing of the signal components may result in severe peaking, minimizing the peak-to-average power ratio of the signal permits increased efficiency of systems whose capacity is peak-power limited. The problem is formulated in terms of the variations from a constant value of the envelope squared of the signal. An error function is specified and used as the basis for evaluating the merits of any spectral phase distribution. Dissert. Abstr.

N68-25061 Tennessee Univ., Knoxville.
CURRENT DISTRIBUTIONS, IMPEDANCES, AND PATTERNS OF CIRCULAR ANTENNA ARRAYS USING AXIAL DIPOLES
Charles Edward Hickman (Ph.D. Thesis) 1966 285 p
Available from Univ. Microfilms: HC $12.85/MF $3.70

This dissertation has developed the integral equation for the circular antenna array and applied a method of iteration to obtain the first order solution for the current distribution and sequence impedances. The procedure for obtaining higher order solutions is outlined and the accuracy of the first order solution is discussed. It is shown that the element factor for a half wave dipole is unaffected by the first order current distribution as compared with

the sinusoidal distribution. The Gaussian quadrature formula is applied to the integral equation to produce a direct solution for the current and impedance. The results agree closely with second order results. Dissert. Abstr.

N68-25100# Signals Research and Development Establishment, Christchurch (England).
A METHOD FOR MEASURING THE OCCUPIED BANDWIDTH OF FM-PCM RADIO TRANSMISSIONS
A. M. J. Mitchell Jun. 1967 36 p refs
(SRDE-67010) CFSTI: HC $3.00/MF $0.65

The report gives full details of the measuring equipment and its method of use. Possible sources of error are investigated and it is concluded that the principal source of error is systematic and arises from the finite cut-off characteristic of the low-pass filter used for the measurement. Results are presented for measurements on transmitter spectra whose occupied bandwidths fall in the range 320 to 700 Kc/s. The estimated errors (which depend on spectrum power distribution) range from ±2 to ±7%. Author

N68-25112 Maryland Univ., College Park.
SOME EFFECTS OF INTER-ELEMENT CORRELATION AND CLIPPING ON THE PERFORMANCE OF RECEIVING ARRAYS
Cabell Nicholas Pryor, Jr. (Ph.D. Thesis) 1966 122 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-2392

This paper discusses some aspects of the performance of receiving arrays in the presence of correlated background noise, for both linear and clipped processing techniques. Expressions are developed for the gain of an array with linear processing a non-uniform correlated noise field, and an optimum linear weighting is derived and shown to be information-lossless in the gaussian case. An expression for the gain of an array employing hard clipping of the receiver outputs is derived for the case of non-uniform correlated receiver noises. The performance of the clipped array in a non-uniform noise field is compared with that for linear processing, and it is shown that a clipped array may out-perform a uniformly weighted linear array under these conditions. However, it is also shown that an error in apparent signal arrival time may occur when a clipped array is used in a non-uniform noise field, and that this error may become large enough under some conditions to limit the usefulness of clipped array processing. Dissert. Abstr.

N68-25170 Ohio State Univ., Columbus.
SYNTHESIS OF A CLASS OF RADAR AMBIGUITY FUNCTIONS
Morgan Stuart Waugh (Ph.D. Thesis) 1966 180 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-2558

This paper is concerned with the specification of surfaces for which the ambiguity volume above a narrow strip along the frequency axis of the t-f plane is maximally concentrated between arbitrary Doppler frequencies $\pm\Omega$ cycles per second. For a known target range, it has been shown that amplitude modulated pulses of duration T may be found which minimize the matched filter response to signals of Doppler shifts greater than $\pm\Omega$. The envelope of these pulses is related to a truncated zero-order prolate spheroidal wave function of parameter $c = \pi\Omega T$. Methods for approximating the desired bandlimited signal by a frequency modulated, rectangular envelope pulse have been investigated. A second realization of the band-limited spectrum may be obtained by amplitude modulating a linearly frequency modulated pulse of the CHIRP variety. The optimum distributions of ambiguity along the time and frequency axis have been treated as separate problems. Dissert. Abstr.

N68-25184*# Illinois Univ., Urbana. Biological Computer Lab.
INFORMATION TRANSFER IN COMPLEX SYSTEMS, WITH APPLICATIONS TO REGULATION Interim Scientific Report
Roger C. Conant Jan. 1968 213 p refs Sponsored in part by NASA
(Contract AF 33(615)-3890; Grant AF-AFOSR-7-67)
(NASA-CR-94739; AFOSR-68-0727; TR-13; AD-667812) CFSTI: HC $3.00/MF $0.65 CSCL 09D

The study is concerned with information theory and its relevance to the study of complex systems. When information about every detail of their activity is kept, many systems are too complex to be manageable and can only be dealt with by sacrificing detail. It is shown here that multivariable information theory is capable of eliminating much detail while preserving information about the interrelations between parts of a system, even when those interrelations are very complex. A procedure is described and exemplified, for example, which is helpful in the decomposition of hierarchical systems. It is shown, among other results, that when two variables are related (in the set theoretic sense) the transmission between them is maximized when their behaviors are isomorphic. This observation leads to an algorithm for the computation of channel capacity for arbitrary finite-state systems of a very general type. The importance of information in regulatory processes is discussed and quantified, and several basic regulatory schemes are discussed in terms of the information involved, showing in an exact way how information transfer and channel capacity limit the ability of any system to act as a successful regulator. Author (TAB)

N68-25187# Advisory Group for Aerospace Research and Development, Paris (France).
SUB-SURFACE COMMUNICATIONS
1966 654 p refs In FRENCH and ENGLISH Selected papers presented at the 12th Symp. of the AGARD Avionics Panel, Paris, 25–29 Apr. 1966
(AGARD-CP-20) CFSTI: HC $3.00/MF $0.65

N68-25187 through N68-25216 cover conference papers on lithospheric propagation and propagation involving water and ice. The papers are grouped into electromagnetic propagation theory, literature review, measurement of electrical characteristics, propagation models, electromagnetic noise, and antenna efficiency.

N68-25188# France. Ministere des Armees, Paris. Centre d'Etudes Theoriques de la Detection et des Communications.
NUMERICAL RESULTS CONCERNING A SURFACE WAVE GUIDED BY THE SURFACE OF THE SEA [RESULTATS NUMERIQUES CONCERNANT UNE ONDE DE SURFACE GUIDEE PAR LA SURFACE DE LA MER]
Maurice Bouix et al *In* AGARD Sub-Surface Commun. 1966 p 1–16 refs In FRENCH (See N68-25187 14-07)

Attention is given to the surface wave guided by the plane surface that separates the electromagnetic properties of the sea and the air. The presented calculations do not correspond exactly with reality because the effects of the ionosphere were not considered. However, they do point to the difficulties encountered in submarine communications. Transl. by M.W.R.

N68-25189# Commissariat a l'Energie Atomique, Saclay (France).
THE THREE MEDIUMS AIR-GROUND PROBLEM. CALCULATION OF FIELDS IN A PERFECT GROUND CONDUCTOR, PRODUCED BY A VERTICALLY POLARIZED ELECTRIC SOURCE RAISED IN ALTITUDE: NUMERICAL APPLICATIONS [LE PROBLEME AIR-SOL A TROIS MILIEUX. CALCUL DES CHAMPS DANS LE SOL CONDUCTEUR PARFAIT, PRODUITS PAR UNE SOURCE ELECTRIQUE POLARISEE VERTICALEMENT, ELEVEE EN ALTITUDE. APPLICATIONS NUMERIQUES]
Pierre Halley et al *In* AGARD Sub-Surface Commun. 1966 p 17–56 refs In FRENCH (See N68-25187 14-07)

Electromagnetic fields were calculated, principally those tangent to the ground surface and produced by a vertical electric dipole source located in the atmosphere and transmitting at frequencies so that the ground could be considered as a perfect conductor. The problem was first considered in two media, omitting the influence of the ionosphere; and the Hertz potential and axial vector were used to evolve the mathematical models. The van der Pol solution and a valid approximation were found for the case of conductivity in the ground, and the results of Norton based on these findings are included. Expressions are given for the case of electric and magnetic fields for a ground conductor that acts like a metal. The problem of three media is then considered, that is, the air-ground interface is treated in the presence of an isotropic and homogeneous ionosphere that is limited by a blunt edge. The Hertz potential was used to find an expression that indicates the altitudes of the sources in both the ground and the ionosphere. A numerical application is included for the case of the sea and the ground in both the presence and absence of ionosphere.
Transl. by M.W.R.

N68-25190# Commissariat a l'Energie Atomique, Saclay (France).
IMPORTANT EFFECTS OF A PHYSICAL DIELECTRIC-METAL DISCONTINUITY ON THE PROPAGATION OF CROSS-OVER ELECTROMAGNETIC WAVE [EFFETS IMPORTANTS D'UNE DISCONTINUITE PHYSIQUE DIELECTRIQUE-METAL SUR LA PROPAGATION DE L'ONDE ELECTROMAGNETIQUE QUI LA FRANCHIT]
Pierre Halley *In* AGARD Sub-Surface Commun. 1966 p 57–96 refs In FRENCH (See N68-25187 14-07)

An attempt was made to separate the principal effects of a dielectric-metal physical discontinuity and to determine its effects on electromagnetic communications over soil, ground, and sea surfaces. Propagation was investigated in a finite conductivity that was homogeneous; and terms were developed for the general case as well as for ground and sea waves. The phenomenon of refractivity was studied for a plane homogeneous wave that acted like a conducting metal; and the index of refraction and coefficients of absorption and wave transmission were determined as a function of the angle of incidence. The particular aspects of metallic refraction were then studied, and it was shown that the physical discontinuity permits one to distinguish between a surface wave and one that penetrates. Differences between a subterranean and underwater antenna were studied, and the vertical and horizontal polarizations were compared.
Transl. by M.W.R.

N68-25194# Army Electronics Labs., Fort Monmouth, N. J. Inst. for Exploratory Research.
LITHOSPHERIC RADIO PROPAGATION—A REVIEW
S. Benedict Levin *In* AGARD Sub-Surface Commun. 1966 p 147–178 refs (See N68-25187 14-07)

The feasibility of linking sub-surface stations by radio propagation entirely through the rocks of the earth's crust, over paths several hundred to thousands of kilometers long, depends upon several sets of critical geophysical factors. Among these are: (1) the geologic structure of the crust; (2) the compositional variations of the major rock facies, both laterally and in depth; (3) the electrical conductivity, dielectric permitivity, and intrinsic attenuation of these rock facies as a function of temperature, frequency, and pressure; (4) the temperatures and temperature gradients in the crust. Little is known about these properties of the crust by direct observation below a depth of about 3 km, but (by extrapolation and inference) if any favorable zone does exist, it will be found between depths of about 6 to 25 km. Current knowledge does not rule out the probability of achieving radio communication through the crust, but several unfavorable aspects are revealed by careful analysis of the geophysical factors.
Author

N68-25195# Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux (France).
PROPAGATION OF RADIOELECTRIC WAVES IN THE EARTH'S CRUST (COMPLETE OUTLINE) [LA PROPAGATION DES ONDES RADIOELECTRIQUES DANS L'ECORCE TERRESTRE (EXPOSE D'ENSEMBLE)]
A. M. Rjazancev and A. V. Shabel'nikov *In* AGARD Sub-Surface Commun. 1966 p 179–210 refs Transl. into FRENCH from Russian J. Article In FRENCH (See N68-25187 14-07)

Theoretical and experimental studies are reviewed that give the physical and electrical properties of the earth's crust and their relationships to temperature, pressure, and humidity. Methods for calculating the field in an absorbant medium are given when the electrical properties are constant in time and space, or when they vary in space according to a determined direction.
Transl. by M.W.R.

N68-25200# Navy Underwater Sound Lab., New London, Conn.
SURFACE TO SURFACE AND SUB-SURFACE TO AIR PROPAGATION QUASI-STATIC AND NEAR-FIELD RANGES
Peter R. Bannister *In* AGARD Sub-Surface Commun. 1966 p 309–333 refs (See N68-25187 14-07)

The electric and magnetic field components produced by vertical and horizontal dipoles (both electric and magnetic types) are treated theoretically for the quasi-static and near-field ranges. The depth h of the transmitting dipole is less than or equal to zero, while the height z of the receiving antenna above the plane conducting homogeneous earth varies from zero + to some height z which is much less than the ionospheric reflecting height (ionospheric effects are neglected). The horizontal separation ρ between the transmitting and receiving antennas is comparable to the receiving antenna height z. The derivations are based upon the quasi-static and near-field approximations to the vector potentials for the vertical and horizontal dipoles and upon application of the reciprocity theorem. It is observed that the sub-surface to air propagation equations reduce to well known expressions when $\rho >> z$.
Author

N68-25201# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences and Aeronomy.
ATTENUATION OF VLF RADIO WAVES PROPAGATING OVER THE ANTARCTIC ICECAP
J. H. Crary and D. D. Crombie *In* AGARD Sub-Surface Commun. 1966 p 335–338 refs (See N68-25187 14-07)

Recordings have been made at Byrd Station, Antarctica, of 16 kc/s signals propagating over both the short and long great-circle paths, which have lengths of 16,300 km and 23,800 km, respectively. The short path contains a portion of the Antarctic icecap about 1250 km long with a maximum ice depth of about 3600 m and an average depth of about 1800 m. The icecap portion of the long path is about 725 km long with a maximum depth (at Byrd) of about 2600 m and an average depth of about 1700 m. The observations indicate that the strongest signals from GBR are received over the great-circle path which is in darkness. As a result, the signal amplitude shows two maxima each day, corresponding approximately to the times of maximum darkness on each path; at these times, the signal from the other path is negligible. By comparing the two daily values of maximum signal, knowing the lengths of the paths, it is possible to deduce the difference in the average attentuation rates of the two paths. This procedure was used to analyze data when the icecap was either all dark or all illuminated. It was deduced from seven sets of daytime (Antarctic summer) data that the attenuation rate of the icecap when sunlit was between 17 and 31 dB/1000 km. Nighttime data similarly indicated nighttime attenuation rates of 17 to 22 dB/1000 km.
Author

N68-25203# Lille Univ. (France).
GROUND COMMUNICATIONS [COMMUNICATIONS A TRAVERS LE SOL]
Robert Gabillard *In* AGARD Sub-Surface Commun. 1966 p 355–386 refs In FRENCH (See N68-25187 14-07)

Experimental ground studies were made to establish the actual communications by low frequency electromagnetic waves between their transmission and their reception in various natural ground cavities or in mines. Telegraphic and telephonic communications could be obtained at distances up to 4 km by using vertically polarized sound waves. A connection was realized with a horizontally polarized wave between the ground surface and a point located at a depth of 500 m. Studies of the transmission by surface waves were conducted at distances up to 7 m. Transl. by M.W.R.

N68-25204# Massachusetts Inst. of Tech., Cambridge. Dept. of Geology and Geophysics.
MODEL RESULTS IN UNDERGROUND COMMUNICATIONS
Anthony F. Gangi *In* AGARD Sub-Surface Commun. 1966 p 387–408 refs (See N68-25187 14-07)

Laboratory model experiments were performed to investigate the propagation of electromagnetic waves in a conducting lithospheric duct (granitic basement layer). The real earth situation was approximated by a finitely conducting layer with uniform properties located between two highly conducting layers (the upper crust and the mantle). Comparisons made with theoretical calculations showed good correlation. Models were also used to investigate the effects of geological discontinuities and inhomogeneities on the electric field strength. The conductivity of the carbon sheet accurately modeled the value of conductivity assumed for the upper crust. The propagation of millisecond pulses in the granitic layer were also investigated in these models by using nanosecond pulses. The nanosecond pulses were launched using log-periodic antennas. The properties of these log-periodic antennas as pulse launchers was investigated in some detail. The reflections of the pulses from the bounding surfaces of the duct were observed and compared with expected results. Author

N68-25205# Sud-Aviation, Paris (France).
PROPAGATION OF VERY LOW FREQUENCIES FROM EXPERIMENTS ON 40 HERTZ TRANSMISSIONS [PROPAGATION DES FREQUENCES TRES BASSES COMPTE RENDU D'EXPERIENCES DE TRANSMISSION A 40 HERTZ]
H. Gutton et al *In* AGARD Sub-Surface Commun. 1966 p 409–423 In FRENCH (See N68-25187 14-07)

Conditions for the study of propagation at very low frequencies were explored; and attention was given to reception by a coil with an iron core, the interference field, and the source of emission used in the study. The high degree of stability of the field was shown in terms of atmospheric conditions, seasonal variations, and ground humidity. These very low frequencies did not exhibit any of the characteristics of the hertzian waves. With the weak power used, it was almost possible to receive a signal at 40 km, and this signal probably is equivalent to one received on shore from a submarine at a depth of 300 to 400 m. No difficulties were found in communication at very low frequencies when higher transmission powers were used. Transl. by M.W.R.

N68-25208# Raytheon Co., Norwood, Mass.
SUB SURFACE RADIO PROPAGATION EXPERIMENTS
Carson K. H. Tsao and J. T. de Bettencourt *In* AGARD Sub-Surface Commun. 1966 p 471–490 refs (See N68-25187 14-07)
(Contract AF 19(628)-2362)

Propagation experiments were conducted to determine the feasibility of communication between vertical linear antennas located in drill holes in the rock below overburden, and similar antennas located on the surface of the ground. The bulk conductivity of the propagation media, i.e., the average conductivity along the path between the antennas, must be determined by measurements of propagation loss and transmission delay, because of the lack of homogeneity in the rock media. High values of bulk conductivity limited experiments to the VLF region on Cape Cod and the Adirondacks, which involved ranges of one mile and three miles, respectively. Distances up to 30 miles in the LF region were achieved by up-and-over transmissions from inside Cheyenne Mountain. Analysis of the experimental results and theoretical considerations indicate that the usefulness of the through-the-rock mode is severely limited by the bulk conductivity. For shallow antenna depths, particularly if the overburden is thin or absent, substantial transmission ranges can be achieved by using the up-over-down of propagation. Author

N68-25209# DECO Electronics, Inc., Boulder, Colo.
NOTES REGARDING POSSIBLE FIELD STRENGTH VERSUS DISTANCE IN EARTH CRUST WAVE GUIDES
A. D. Watt, G. F. Leydorf, and A. N. Smith *In* AGARD Sub-Surface Commun. 1966 p 491–519 refs (See N68-25187 14-07)

Propagation between buried terminals via two paths at distances up to 100 km is considered. The first path is that of a doubly refracted wave which travels in the earth ionosphere region. The second is a wave propagated in the basement rock between the conducting overburden and the conducting region at depths of tens of kilometers. The terminals are located in the basement rock directly below the highly conducting overburden. It is shown that in the range of distances considered, relatively more efficient propagation will frequently be via the path in the basement. Author

N68-25210# Texas Univ., Austin. Electrical Engineer Research Lab.
ULF-ELF EARTH MODE COMMUNICATIONS VIA HORIZONTAL ELECTRIC DIPOLES AT THE SURFACE
D. R. Word, F. X. Bostick, Jr., and Leon A. Ames (AFCRL, Bedford, Mass.) *In* AGARD Sub-Surface Commun. 1966 p 521–541 refs Sponsored in part by AFCRL (See N68-25187 14-07)

ELF signals induced in the earth are shown to offer a means for reliable, short range, low data rate communications. This paper is concerned with use of the horizontal electric dipole as a source. The basic field relationships are presented and parameters necessary for the evaluation of this communications mode are discussed in the light of obtainable information capacity. Author

N68-25214# Air Force Cambridge Research Labs., Bedford, Mass.
REVIEW OF THE EARTH MODE COMMUNICATION PROGRAM AT AIR FORCE CAMBRIDGE RESEARCH LABORATORIES
Leon A. Ames, John W. Frazier, and Arnold S. Orange *In* AGARD Sub-Surface Commun. 1966 p 607–619 refs (See N68-25187 14-07)

Emphasis is placed on geological and geophysical problems encountered in the course of the program. Communications modes studied included: (1) "deep-strata", wherein radio frequency electromagnetic waves are propagated between buried antennas over a path entirely within rock strata, and (2) "conduction current", consisting of ULF conduction field communications between long, grounded dipoles. Deep-strata studies were carried out utilizing both loops and linear antennas immersed in the rock medium. Antenna and transmission path characteristics were studied under a variety of conditions and over paths up to 4.5 km in length. It was found that two of the greatest problems facing the communicator are the complexity of the earth's crust and its low values of electrical resistivity. Conduction field studies were performed using what was essentially the dipole-dipole geophysical resistivity sounding technique. Field tests were made at frequencies from 0.01 Hz to 10 Hz and at ranges to 32 km. Author

N68-25215# Advisory Group for Aerospace Research and Development, Paris (France).
STUDY OF RECEPTION IN THE OCEAN BY DIPOLE AND VOLUMETRIC ANTENNA [ETUDE DE LA RECEPTION DANS LA MER PAR DIPOLE ET ANTENNE VOLUMETRIQUE]
B. Blachier et al *In its* Sub-Surface Commun. 1966 p 621-628 In FRENCH (See N68-25187 14-07)

Low frequency magnetic dipoles are treated, and the formulas for the noise signals in the air and in the sea are given for both weak and strong submersions. Algebraic expressions define the recovery surface, and a volumetric antenna is described for which gains of 40 dB can be realized. Transl. by M.W.R.

N68-25216# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
IMPEDANCE AND RADIATION EFFICIENCY OF BURIED DIPOLE TYPE AND LOOP ANTENNAS
Janis Galejs *In* AGARD Sub-Surface Commun. 1966 p 629-657 refs (See N68-25187 14-07)

The impedance characteristics and the radiation efficiency of buried vertical and horizontal dipole type antennas and loops are computed using variational formulations, and the numerical examples emphasize the frequency range where the conduction currents in the ground are comparable to the displacement currents. A finite electric dipole or a wide top-hat antenna is embedded in an asphalt pad, which is buried below the ground surface. For purposes of the analysis, this antenna geometry is approximated by a cavity backed annular slot antenna of comparable size, and the impedance characteristics of this slot are examined for several sets of trial functions for the aperture fields in the slot plane. For purposes of analysis, a horizontal dipole antenna mode of an insulated cylindrical wire is approximated by a flat strip embedded in a dielectric slab. For the theoretical study of loop antennas the following model is used. A finite flat loop antenna is in the center of an insulating dielectric slab which is embedded either in a thick slab of lossy dielectric or in a semi-infinite lossy medium. A buried insulated loop exhibits about the same efficiency as a buried horizontal dipole whose length is the same as the mean circumference of the loop. Author

N68-25330*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A STUDY OF CODES FOR DEEP SPACE TELEMETRY
D. R. Lumb [1967] 17 p refs Presented at IEEE Conv., New York, 20-23 Mar. 1967
(NASA-TM-X-59768) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Results of computer studies are described for several codes which have promise for application to the deep space telemetry channel. Two rate 1/2 trial and error convolutional codes and two cyclic block codes have been simulated using majority decision decoding for the binary symmetric channel and "a posteriori probability" (APP) decoding for the gaussian channel. In addition to APP decoding, sequential decoding was examined for a rate 1/2 short constraint length convolutional code. The codes were considered from an energy efficiency standpoint for coherent detection of PSK signals. Code performance measures include bit error probabilities, undetected word error probability for six-bit telemetry words, and also detected and undetected word error probabilities when the codes are concatenated with a parity check code. Author

N68-25368*# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Electrical Engineering.
A SPACE COMMUNICATIONS STUDY Progress Report, 15 Sep. 1967-15 Mar. 1968
Kenneth K. Clarke, Raymond L. Pickholtz, and Donald L. Schilling 15 Mar. 1968 53 p refs
(Grant NGR-33-006-020)
(NASA-CR-94775) CFSTI: HC $3.00/MF $0.65 CSCL 17B

A new method for finding the expected number of spikes in a phase locked loop (PLL) of any order, with or without modulation, is presented. The procedure can also be used to determine the threshold of a frequency demodulator with feedback (FMFB), FM discriminators, and the maximum likelihood estimator. Results are presented for the first and second order PLL and for an ordinary FM discriminator. FM threshold extensions are achieved in FM detectors using the PLL, the frequency locked loop (FLL), or the FMFB. The FLL and PLL are shown to be limiting forms of the FMFB. An analysis is made of FM multipath interference and is concerned with the effects produced when a sinusoidally modulated FM signal is received in addition to a delayed attenuated echo of the signal. R.N.A.

N68-25631*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY 37-50. VOLUME 2: THE DEEP SPACE NETWORK BIMONTHLY REPORT, 1 JAN.-29 FEB. 1968
31 Mar. 1968 104 p refs
(Contract NAS7-100)
(NASA-CR-94802) CFSTI: $3.00/MF $0.65 CSCL 17B

The current technical activities of the Deep Space Network are summarized in relation to development for support of future flight projects, implementation of demonstrated capabilities for support of the more immediate flight projects, and direct support for currently active missions. Summary data are included on (1) interplanetary, planetary, and manned spaceflight projects, (2) tracking and data acquisition elements research, (3) communications systems, (4) tracking and navigational accuracy analysis, (5) operation and development of the Space Flight Operations Facility, and Ground Communications Facility, and (6) development progress in the Deep Space Instrumentation Facility. B.S.D.

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N68-24355# Melpar, Inc., Falls Church, Va.
A STUDY OF RANDOM NETWORKS MODELS
Fred Ordway Mar. 1968 21 p
(Contract N00014-66-C0258)
(Rept.-6353.00200-TR-2; AD-667241)

A network made up of corner-sharing polyhedra, all with the same number of vertices, is specified topologically by listing for each vertex the shared adjacent vertex (list of neighbors) or by listing the pairs of shared vertices (list of bonds). Computer routines are given in Fortran II for obtaining the list of bonds from the list of neighbors and for identifying and tabulating all the rings present in the network. The routines, used with an IBM 7090 computer, accommodate 900 bonds, 400 rings, and a maximum coordination number of 6. Author (TAB)

N68-24444# General Electric Co., Santa Barbara, Calif. Tempo Div.
FORTRAN PROGRAMS FOR DATA MANIPULATION
Homer C. Carney and John K. Forbes Aug. 1967 26 p refs
(Rept.-67TMP-71)

This paper introduces the concepts of a data element and functional modularity. The data element and its associated routines allow a user to structure and process data in a manner which suits his problem. This gives the capability of combining array processing with other data manipulation techniques such as list processing. The data element is embedded in a virtual memory. This alleviates the problem of dynamic storage allocation. Functional modularity

permits the changing of a function in a set of routines without changes in other routines. Functional modularity also gives clues to future hardware design. Many of the functions could be duplicated by appropriate hardware features. Author

N68-24491# Instituto de Energy Atomica, Sao Paulo (Brazil).
REVIEW OF PROGRAMS FOR THE IBM 1620 DIGITAL COMPUTER [RESUMO DE PROGRAMAS PARA O COMPUTADOR DIGITAL IBM 1620]
Maximilian Emil Hehl Dec. 1966 39 p In PORTUGUESE
(IEA-6) CFSTI: HC $3.00/MF $0.65

A summary is presented of routines and subroutines for the IBM 1620 computer. A code accompanies each program and contains information on the name of the routine or subroutine, state of the program, program classification, the contributing institution, program language, program number, and report number. The numbers, letters, and symbols used in this code are explained. The programs are listed according to their uses. These include programmed arithematic, elementary functions, polynomials and special functions, operations on functions and solutions of differential equations, interpolation, extrapolation, and approximation, operations on matrices, vectors, and simultaneous linear equations, statistical analysis and probability, search operations and linear programming, executive programs, diagnostic programs, engineering, physics, chemistry, biology, economics and administration, demonstration programs, and service programs. Transl. by R.N.A.

N68-24524# Michigan Univ., Ann Arbor.
SYSTEM/360 INTERFACE ENGINEERING REPORT
David Mills Nov. 1967 177 p refs *Its* Mem. 13
(Contract DA-49-083-OSA-3050; ARPA Order 716; Proj. Concomp)
(AD-667655)

An interface which connects a small special-purpose digital computer to a large general-purpose digital data processing system is described in this report. The small computer is the Digital Equipment Corporation PDP-8 which itself is a component of a data collection and distribution system called the Data Concentrator. The large data processing system is the IBM System/360 Model 67, which is the principal computing element at The University of Michigan Computing Center. The interface is designed to be attached to the multiplexor channel of the Model 67 along with other input-output components such as card readers, line printers, and communications equipment, and satisfies all IBM standards and interface conventions established for this type of attachment. The interface provides a bidirectional data transfer between the two machines of up to 80 thousand bytes (characters) per second using cycle-steal techniques in which data are transferred directly between the Model 67 multiplexor channel and the PDP-8 core memory without explicit program intervention. Author (TAB)

N68-24600# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
ANALYSIS AND RETRIEVAL OF PROCESSED GAMMA SPECTRA DATA
E. L. Wells and W. R. Weissenberger Mar. 1968 57 p refs
(Contract AT(45-1)-1830)
(BNWL-669) CFSTI: HC $3.00/MF $0.65

Four analog-to-digital pulse converter–scintillation detector systems are connected on-line to a PDP-7 digital computer for immediate data processing. Aerosol, liquid, and deposition samples are analyzed. A description of components, coding methods, mathematical treatment, and analytical results is given. NSA

N68-24628# Illinois Univ., Urbana. Dept. of Computer Science.
AN ANALOG INPUT/OUTPUT SYSTEM FOR THE ILLIAC 2
Alton Benjamin Otis, Jr. (M.S. Thesis) 22 Sep. 1967 72 p refs
(Contract AT(11-1)-1469)
(COO-1469-0069; Rept.-246) CFSTI: HC $3.00/MF $0.65

The facility consists of an audio tape recorder/reproducer, which is the source or receiver of analog signals, and an analog input/output interface that accomplishes both analog-to-digital and digital-to-analog signal transformation. NSA

N68-24712# Thomas Bede Foundation, Los Altos, Calif.
EXPANDED STUDY OF DATA PROCESSING AND COMPRESSION TECHNIQUES
Brenda P. Bittner, I. Browning, and N. B. Winkless, III Dec. 1967 47 p refs Prepared for Sandia Corp.
(Contract AT(29-1)-789)
(SC-CR-67-2864) CFSTI: HC $3.00/MF $0.65

The development of methods for the retrieval of information which was previously packed into storage by a modified n-tuple storage method is described. Additionally, investigations carried out on indexing and abstracting by computer are discussed. Author (NSA)

N68-24766# Aeronautical Research Council (Gt. Brit.).
AN ELECTRONIC ANALOG COMPUTER REPRESENTING TWELVE COUPLED LINEAR EQUATIONS
W. D. Hicks London HMSO 1968 54 p refs Supersedes RAE-TR-65294, ARC-28130, X66-21330
(ARC-R&M-3495; RAE-TR-65294; ARC-28130) HMSO: £1 3s

This paper describes the design, construction and operation of an electronic network providing an analogue of the behavior of up to twelve coupled, second-order, linear differential equations. It was designed specifically for the solution of problems in aircraft flutter investigations but can be used for other associated problems or where a problem can be expressed in similar form. Author

N68-24922# Illinois Univ., Urbana. Dept. of Computer Science.
A DESCRIPTION OF THE BASIC ASSEMBLY LANGUAGE FOR ILLIAC 4 (7094 IMPLEMENTATION)
David Grothe 5 Oct. 1967 54 p *Its* Illiac 4 Doc. No. 159

Basic elements of the ILLIAC IV computer assembly language are given in production table forms. Depicted are card format, labels, operation mnemonics, operand field, skip field, and literals. Appendices contain the instruction lists. G.G.

N68-24967*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPUTER PROGRAM FOR SYMBOLIC REDUCTION OF BLOCK DIAGRAMS USING FORMAC
Carl F. Lorenzo and Paul Swigert Washington, D. C. Jun. 1968 78 p refs
(NASA-TN-D-4617) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Techniques have been established and a computer program has been written (in the experimental language, FORMAC) to symbolically reduce arbitrary block diagrams for desired transfer functions. Symbolic solutions are determined in several forms including an expanded form in terms of the driving frequency and system constants. Programs are written to numerically evaluate the symbolic solutions for real and imaginary parts and magnitude ratio and phase angle. The programs have been applied to several research problems which include both lumped and distributed parameter systems. The latter forms are built into the program and are handled automatically. Author

N68-25002*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
HYDRA 1 DATA DISPLAY SYSTEM
Roger L. Hodgkins and Donald R. Osgood Washington May 1968 22 p
(NASA-TN-D-4554) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Details are given on the Hydra 1 which is an extremely flexible and versatile data display system. A television monitor screen serves as a working surface upon which an operator can develop, or create, graphic displays such as written documents, charts, diagrams, graphs, background slides, and other graphic art through the use of special control keyboards and operating techniques. An operator can create, rearrange, delete, or add to the graphic display to develop any desired format. Upon completion of a graphic display, it can be recorded in a magnetic tape library, plotted on an X–Y plotter, recorded as a punched paper tape, or recorded as a frame of a sequential playback magnetic tape. Displays recorded in the magnetic tape library can be recalled for examination or revision. Author

N68-25033 State Univ. of Iowa, Iowa City.
MATHEMATICAL TECHNIQUES TO IMPROVE THE ACCURACY OF COMPUTER GRAPHIC DEVICES DESPITE HARDWARE LIMITATIONS
Cloy Joseph Walter (Ph.D. Thesis) 1966 87 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-2691

The aim of this research was to contribute to the advancement of the computer/mathematics fields by demonstrating that mathematical techniques can be applied to increase the accuracy of an electronic device. This goal was achieved. Accumulated results show mathematically that a visual display system can produce accurate images, i.e., that an *inaccurate* computer peripheral device can provide *accurate* data output. The problem of producing an accurate image with a computer-controlled visual display system was assumed to be a process control problem or a process model building problem. The results of this research demonstrate that the accuracy of a computer graphic device can be improved by mathematical methods. Dissert. Abstr.

N68-25146# California Univ., Livermore. Lawrence Radiation Lab.
CERTAIN PROBLEMS IN GRAPHIC DATA PROCESSING
George A. Michael Jan. 1968 16 p refs To be presented at the Intern. Conf. on System Sci., Honolulu, Hawaii
(Contract W-7405-ENG-48)
(UCRL-70902; CONF-680106-1) CFSTI: HC $3.00/MF $0.65

Questions and problems which have been encountered in using computers for graphic data processing are restated and briefly examined. Such questions as user qualifications and the determination of the best computer system for a specific use are reviewed. NSA

N68-25171# Illinois Univ., Urbana. Computer Science Dept.
ILLIAC 4 Quarterly Progress Report, Oct.–Dec. 1967
1 Feb. 1968 27 p refs *Its* ILLIAC 4 Doc. No. 176
(Contract AF 30(602)-4144)
(Rept.-256; AD-667280)

Contents: Hardware - System design; Diagnostic programming; Software - Language translator writing system; Tranquil; Gleipnir; System K; Applications - Partial differential equations; Signal processing; Matrices; Linear programming; Computer graphics; Weapons effects calculations; Anthropology applications. TAB

N68-25260# Oak Ridge National Lab., Tenn.
APPLICATION NOTES ON THE IMMEDIATE ANALYSIS COMPUTER DISPLAY SYSTEM FOR ORELA DATA ACQUISITION AND HANDLING
J. W. Reynolds 30 Jan. 1968 19 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2116) CFSTI: HC $3.00/MF $0.65

A possible equipment configuration for the immediate analysis of ORELA experimental data is described. Minimum software requirements are stated. Light pen interactions with a data set are shown on an existing system. Several examples of how the displays could be used in particular experiments are discussed briefly. Author (NSA)

N68-25267# New York Univ., N. Y. AEC Computing and Applied Mathematics Center.
A COMPUTER PROGRAM FOR DOING TEDIOUS ALGEBRA (SYMB66)
Arnold Lapidus, Max Goldstein, and Susan S. Hoffberg Jan. 1968 48 p refs
(Contract AT(30-1)-1480)
(NYO-1480-88) CFSTI: HC $3.00/MF $0.65

In a previous paper by Lapidus and Goldstein (Comm. ACM 7: 501(1965)) a simple experimental algebraic manipulator which consisted of a set of subroutines for doing elementary algebra with expressions which were essentially polynomials has been described. A new program (SYMB66) which would include arbitrary functions of one variable and differentiation capabilities as well as a more problem-oriented appearance is presented. NSA

N68-25268*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DIGITAL SPECTRAL ANALYSIS
Anthony J. Villasenor Washington Jun. 1968 49 p refs
(NASA-TN-D-4510) CFSTI: HC $3.00/MF $0.65 CSCL 09B

This paper presents some mathematical considerations of spectral analysis and some FORTRAN computer programs that use the Fast Fourier Transform algorithm of Cooley and Tukey. These programs compute Fourier amplitude and phase spectra, cross-power spectra, auto- and cross-correlation, and filtered spectra, as well as some other frequency domain functions. Author

N68-25558# Polish Academy of Sciences, Cracow. Inst. of Nuclear Research.
SOLUTION OF A SYSTEM OF LINEAR EQUATIONS BY MEANS OF THE LEAST SQUARE METHOD IN THE CRACOVIANS ALGORITHM. PROGRAM FOR THE ODRA 1003 COMPUTER [ROZWIAZYWANIE UKLADU ROWNAN LINIOWYCH METODA NAJMNIEJSZYCH KWADRATOW W UJECIU KRAKOWIANOWYM. PROGRAM DLA MASZNY ODRA 1003]
A. Gonsior Jan. 1968 28 p ref In POLISH; ENGLISH summary
(INP-587/PL) CFSTI: HC $3.00/MF $0.65

A program for the ODRA 1003 computer is presented for solution of a system of linear equations by means of the least squares method in the Cracovian algorithm. Author

N68-25596# Joint Publications Research Service, Washington, D. C.
AUTOMATIC PROGRAMMING SYSTEM FOR BESM-6 COMPUTER
Ye. A. Zhogolev 23 May 1968 14 p refs Transl. into ENGLISH from the book "Vychislitel'nyye Metody i Programmirovaniye" Moscow, Univ. Publ. House, v. 9, 1967 p 2–17
(JPRS-45468) CFSTI: HC $3.00/MF $0.65

The general organization of the automatic programming procedure developed for the high capacity Soviet BESM-6 computer is discussed in terms of simplifying the preparation of problems for computer solution. The BESM-6 has a speed of up to a million operations per second, high capacity of all types of memory, and an interrupt system that permits parallel execution on various devices for simultaneous solution of several problems. Requirements imposed on the computer are that the language used must be convenient for the human operator, permit broad use of a library of standard subroutines, and be compatable with the various

algorithmic languages executed on the computer. Requirements imposed on the internal language were achieved by an insignificant increase in the space allocated in the external memory for storage of the subroutine. M.W.R.

N68-25602# Oak Ridge National Lab., Tenn.
A COMPUTER CODE FOR STORING AND RETRIEVING DATA AND DEVELOPING IMPROVED SOLIDS FOR FIXATION OF HIGHLY RADIOACTIVE WASTES
C. L. Fitzgerald, H. W. Godbee, M. H. Davis, and W. E. Clark Mar. 1968 27 p ref
(Contract W-7405-ENG-26)
(ORNL-3824, Sup. 1) CFSTI: HC $3.00/MF $0.65

A supplement is designed for arranging in order and comparing the data previously collected. Any data may be stored in the program. In the future, the code will aid in the prediction of new, improved solids for long-term storage of waste by using the collected and collated data. A flow chart for the FORTRAN II program used is given. NSA

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N68-24387*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUPPRESSION OF TEMPERATURE RISE IN LOSSY DIODES INSIDE RESONANT CAVITIES BY APPLICATION OF PRESSURIZED LIQUID NITROGEN
Hans-Juergen C. Blume Washington May 1968 31 p refs
(NASA-TN-D-4556) CFSTI: HC $3.00/MF $0.65 CSCL 09A

The suppression of temperature rise in lossy diodes due to electrical power dissipation inside resonant cavities of low noise devices such as parametric amplifiers is essential in maintaining optimum low noise performance. This suppression can be achieved by the application of pressurized liquid nitrogen inside the cavity. The expected temperature of the lossy diode under this condition is estimated by (1) a calculation based on the heat-flow equations, and (2) a salt-solution test. The results are correlated with direct measurements which reveal a temperature rise of 3.3°K above the temperature of liquid nitrogen at 1 atmosphere. The resonant frequency shift due to the liquid nitrogen dielectric is estimated and its correlation with measurements is included. The results indicate that this type of cooling can be successfully used and is particularly effective for parametric amplifiers with medium quality varactor diodes. Author

N68-24388*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
LOW DRIVE TEMPERATURE STABLE MEMORY CORES
Howard Lessoff Washington May 1968 10 p refs
(NASA-TN-D-4573) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Details are given on the use of calcium and molybdenum as substitutes in the preparation of temperature-stable memory cores. Substituted lithium compositions which effectively improve core uniformity and lower the power required in memory application have been developed for memory cores. These improvements have been achieved by control of the ceramic structure, lowering of the coercivity, and reduction of the sintering temperature. Author

N68-24389*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A DIGITAL VOLTAGE-CONTROLLED OSCILLATOR FOR PHASE LOCK LOOPS
Dominick E. Santarpia and Thomas E. McGunigal Washington May 1968 16 p refs
(NASA-TN-D-4521) CFSTI: HC $3.00/MF $0.65 CSCL 09E

The development of a digital voltage-controlled oscillator phase lock loop is described. A large frequency-tracking range and high phase stability are conflicting requirements of a conventional voltage-controlled oscillator; however, a digitally controlled frequency synthesizer performing in place of the conventional tracking oscillator will provide the stability and spectral purity of a very good 1-MHz standard over very wide frequency excursions. Author

N68-24395# Chalmers Univ. of Technology, Goteborg (Sweden). Research Lab. of Electronics.
CYCLOTRON WAVE AMPLIFICATION USING SELF GENERATED PUMP POWER
Jan Jaederblom 15 Dec. 1966 24 p
(Contract AF 61(052)-594)
(RADC-TR-68-108; TN-13; RR-66; AD-667564)

This report describes measurements on an amplifier system consisting of two cascaded Adler tubes with a traveling wave tube (TWT) to amplify the pump signal. The latter was produced by the signal itself in the quadrupole of one of the Adler tubes. By so doing the pump voltage was phase locked to the signal. Two cases were investigated. In one case the pump power was generated in the first Adler tube, amplified in the TWT and then used for pumping the second Adler tube. The dB gain of this system is a linear function of the input signal power. In the other case the pump power was taken from the second Adler tube, amplified in the TWT and then fed back to pump the first Adler tube. Now the dB gain becomes a linear function of the output power. A theoretically predicted hysteresis effect was experimentally verified. Author (TAB)

N68-24418# Space Craft, Inc., Huntsville, Ala.
PULSE DURATION MODULATION MULTIPLEXER Final Report, Jun.–Sep. 1966
John G. Howell Wright-Patterson AFB, Ohio. AMRL Dec. 1967 28 p
(Contract AF 33(615)-5076)
(AMRL-TR-66-164; AD-667285)

The report describes the research and development study of a pulse duration modulation multiplexer for use in personal telemetry systems. The objective of the program was to develop a low power, accurate pulse duration modulation multiplexer which has the potential of small physical size and low weight. The technical approach includes the design of low power logic, the use of the most advanced multiplexer switch, and the development of a unique amplification and comparison technique. All the system general requirements and specific requirements are satisfied by the design. The system performance is demonstrated by a laboratory breadboard model. Results of the tests performed on the model verify the feasibility of the engineering design. Author (TAB)

N68-24466# Naval Ammunition Depot, Crane, Ind.
μ-NOTES—INFORMATION ON MICROELECTRONICS FOR NAVY EQUIPMENTS
1 Apr. 1968 216 p *Its* No. 23
(AD-667719)

The Micro-NOTES contain information on evaluation, application, availability, research and development, and standardization activity pertaining to state-of-the-art microelectronic circuits, devices, and materials, with a view toward avoiding duplication of effort and making maximum use of technical resources. Author (TAB)

N68-24764# Siemens-Schuckertwerke A. G., Erlangen (West Germany). Forschungslab.
THE DEVELOPMENT OF INTEGRATED POWER COMPONENTS BASED ON PLANAR TECHNIQUES, PARTICULARLY

FOR USE IN SATELLITES [ENTWICKLUNG VON INTEGRIERTEN LEISTUNGSBAUELEMENTEN IN PLANARTECHNIK, VOR ALLEM FUER DEN EINSATZ IN SATELLITEN]
H. H. Arndt, A. Meuller, M. Pulver, B. Reiss, J. Schaedel et al
Bad Godesberg, West Ger. Bundesmin. fuer Wiss. Forsch. Jan. 1968 181 p refs In GERMAN; ENGLISH summary
(BMWF-FB-W-68-04) CFSTI: HC $3.00/MF $0.65

The quality and stability of components manufactured by planar techniques are influenced strongly by freedom from defects in the oxide layer, the dielectric strength of this layer and by the number of surface states at the oxide-silicon interface. New methods have been developed and tested for improving the properties of the oxide layer. Fundamental investigations directed towards the production of high-grade silicon surfaces have led to modified solvents and their application for the plane and polishing etching of ground silicon samples. Studies are being made of DC-DC-converter arrangements to ascertain their suitability for integration or partial integration. Author

N68-24797# Hahn-Meitner-Institut fur Kernsforschung, Berlin (West Germany).
EFFECTS OF IONIZING Co-60-GAMMA-IRRADIATIONS ON THE PROPERTIES OF MOS- AND MNS-FIELD EFFECT TRANSISTORS [WIRKUNGIONISIERENDER Co-60-GAMMA-STRAHLUNG AUF MOS- UND MNS-FELDEFFEKT-TRANSISTOREN]
H.-G. Wagemann Mar. 1968 88 p refs In GERMAN; ENGLISH summary
(BMWF-FB-W-68-17) CFSTI: HC $3.00/MF $0.65

This paper gives an introduction into physics and measuring technique of the most important characteristics and a short review of the analysis of radiation damage of the mentioned semiconductor devices. The electrical behaviour of MOS- and MNSFET's being irradiated by a 3000 Curie Co-60-hotspot is discussed by means of curve-families, transconductance, gate-capacitance and surface recombination velocity. The change of the electrical charge in the insulating layer and at the interface between semiconductor and insulator is considered. Author

N68-24803# Siemens-Schuckertwerke A. G., Erlangen (West Germany).
EXPERIMENTAL INVESTIGATIONS CONCERNING THE EQUIVALENCE OF ELECTRONS, PROTONS AND X-RAYS FOR DEGRADATION OF TRANSISTOR GAIN [EXPERIMENTELLE UNTERSUCHUNGEN UEBER DIE AEQUIVALENZ VON ELEKTRONEN, PROTONEN UND ROENTGENSTRAHLEN BEI DER STRAHLENSCHAEDIGUNG VON TRANSISTOREN]
R. Baeuerlein Mar. 1968 33 p refs In GERMAN; ENGLISH summary
(BMWF-FB-W-68-19) CFSTI: HC $3.00/MF $0.65

The paper deals with the experimental determination of the fluence equivalent of electrons, protons and X-rays, which produces the same degradation in current gain of silicon transistors. Comparison between the experimental and calculated fluence equivalent allows to distinguish whether the damage of a semiconducting device is caused by production of defects or by ionization effects. The dependence of surface radiation damage to dose rate which was investigated on silicon planar devices is very less. Author

N68-24805# Hahn-Meitner-Institut fur Kernforschung, Berlin (West Germany).
RADIATION DAMAGE OF BIPOLAR TRANSISTORS BY PROTONS (2.5–4.5 MEV) AND BY ELECTRONS (1.5 MEV) [DIE SCHAEDIGUNG VON BIPOLAREN TRANSISTOREN-DURCH BESTRAHLUNG MIT PROTONEN IM ENERGIEBEREICH 2,5–4,5 MEV UND ELEKTRONEN DER ENERGIE 1,5 MEV]
A. Spencker, G. Schnell, H. -G. Wagemann, and O. Meinhardt Mar. 1968 39 p refs In GERMAN; ENGLISH summary
(BMWF-FB-W-68-16) CFSTI: HC $3.00/MF $0.65

In this paper the influence of protons and electrons of the mentioned energies on bipolar transistors is investigated by means of four types of recombination currents, which exist in the base of a bipolar transistor. These different types are separated by analyzing $I_B = f(U_{EB})$ characteristics. Their influence on current gain is discussed by means of the Webster equation. Theoretical introduction and measuring techniques without and with ionizing radiation are described. The results show that unwanted types of recombination current are generated by irradiation especially for low current injections ($I_B = 10^{-9} - 10^{-8}$ A) into the transistor. Semiconductor devices of different origin are compared. Author

N68-25052# Sandia Corp., Albuquerque, N. Mex. Special Test Equipment Design Div.
SE90 SCAN CONVERTER STORAGE TUBE
Cecil R. Mock Mar. 1968 14 p Revised
(Contract AT(29-1)-789)
(SC-TM-67-2978) CFSTI: HC $3.00/MF $0.65

The scan converter storage tube in the SE90 waveform digitizer is a dual electron gun type with an electron bombardment induced conductivity (EBIC) target system and a special traveling-wave deflection system for the signal input. The target system uses a semiconductor as the storage layer for increasing the induced conductivity. The principles of operation are outlined. NSA

N68-25053# Sandia Corp., Albuquerque, N. Mex.
EFFECTS ON HARMONIC DISTORTION ON STABLE LOW-Q OSCILLATORS
R. D. Griffith Feb. 1968 38 p refs
(Contract AT(29-1)-789)
(SC-TM-67-3011) CFSTI: HC $3.00/MF $0.65

The relation between frequency stability, harmonic distortion, and excess gain is derived and compared with experimental data. A figure of merit for the feedback network is derived, and several types of networks are compared, including both lumped and distributed parameter networks. Methods for obtaining improved tolerance to harmonic distortion are discussed. Author (NSA)

N68-25327*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ATM ELECTRICAL INTERFACE
Frank V. Bischof 5 Sep. 1967 51 p refs
(Contract NAS8-21003)
(NASA-CR-61821; LMSC-A842320) CFSTI: HC $3.00/MF $0.65
CSCL 09A

A bending test program was conducted on several electrical cable harnesses using a modified test rig to better simulate the Apollo telescope mount geometry. Summary data are presented on the routing approach, type of load, and degree of angular displacement, and on the wire count for each harness. Test configurations are depicted, along with test torque limits and representative hysteresis curves. The relationship of the data to the recommended design approaches is assesed. M.G.J.

N68-25408# Joint Publications Research Service, Washington, D. C.
THIN FILMS IN MICROMINIATURIZATION OF RADIOELECTRONIC EQUIPMENT
V. V. Slutskaya 16 May 1968 21 p Transl. into ENGLISH from the book "Tonkiye Plenki v Tekhnike SVCH" Moscow, Sov. Radio Publishing House, 1967 p 404-427
(JPRS-45406) CFSTI: HC $3.00/MF $0.65

Procedure for deposition of thin films in a vacuum is discussed, as is the microminiaturization of electronic circuits and other radio electronic equipment. Deposition of contacts, resistances, thin film capacitors, and active thin film circuit elements are discussed in relation to microcircuitry manufacturing processes; as are the vacuum units for the deposition of the microcircuit elements and the automatic production of thin film microminiature circuits. M.W.R.

N68-25524# Gross (T.A.O.) and Associates, Lincoln, Mass.
CROSS FIELD MAGNETIC MODULATOR, MEASUREMENT OF Y PARAMETERS
28 Feb. 1968 21 p refs Sponsored by NASA
(NASA-CR-88056) CFSTI: $3.00 CSCL 09A

Data are presented to show that the cross field magnetic modulator made from a ferrite pot core is a reciprocal device ($Y_{12}=Y_{21}$) when operated with excitation frequency below that of the gyromagnetic resonance of the ferrite. No unusual possibilities from the device-shape anisotropy were noted. However, the cross field device appears to offer advantages in both performance and cost over conventional reactors in high frequency magnetic amplifier and modulator applications. Author

N68-25648*# ITT Industrial Labs., Fort Wayne, Ind.
RESEARCH IN THE DEVELOPMENT OF AN IMPROVED MULTIPLIER PHOTOTUBE
E. H. Eberhardt, F. H. Barr, and P. R. Henkel 16 Feb. 1968 26 p refs
(Contract NASw-1576)
(NASA-CR-94737; ITTIL-68-06; QR-3) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Characteristic parameter values in analog (dc) and digital (single-electron pulse count) modes of information processing were determined for a multiplier phototube, and tube specifications pertaining to these values were set. The dc parameters of anode dark current, operating voltage, and equivalent noise input were recorded at a constant anode responsivity of 2000 amperes per lumen; and three dark current measurements appeared. Two are the usual ones at 1800 and 2000 amperes, while the other one at 1800 volts is an indication of leakage across the stem and dynode thermionic emission. Pulse count data determined at 1800 volts is readily compared with dc data because the number of significant pulses is not generally voltage sensitive. Measured and calculated characteristics of the four tubes were made, typical curves for dark count versus temperatures were plotted, and dark current and [illegible]-k counting rate were correlated. Multipliers with remotely processed cathodes were considered promising because they resulted in clean, cesium free tube interiors. M.W.R.

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N68-24353# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Electrical Engineering.
RESEARCH IN CONTROL THEORY Final Report
L. Shaw Mar. 1968 12 p refs
(Contract DA-31-124-ARO(D)-316)
(PIBEE68-0001; AD-667385)

The report is divided into the following four sections I. Main lines of investigation, II. Main results and conclusions, III. Publications, and IV. Scientific personnel. Three main themes which have developed are: (1) Identification; (2) sensitivity; (3) optimal stochastic control. TAB

N68-24446 Michigan Univ., Ann Arbor.
SYNTHESIS PROBLEMS IN LINEAR THRESHOLD LOGIC
Rodolfo Gonzalez (Ph.D. Thesis) 1966 146 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-1747

The purpose is to study several problems associated with networks of threshold elements. First a test for linear separability is presented, then the problem of two-level threshold minimization is treated and, finally, the synthesis of universal networks is studied. The test for linear separability operates on the inequalities eliminating one at a time, but this is implemented by manipulating the coordinates of a pair of points at a time instead of working on the inequalities themselves. The synthesis of networks of threshold elements which are not limited as to the number of inputs or weights acceptable is treated in two different aspects.
Dissert. Abstr.

N68-24448 Texas Univ., Austin.
REDUNDANCY IN THRESHOLD LOGIC NETWORKS
James Daniel Bargainer (Ph.D. Thesis) 1966 107 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-3246

Methods are presented for designing error correcting capabilities into threshold gate networks so that the logic gates themselves correct errors of the system. A method is first presented which is based on the tree method of Coates and Lewis for the realization of threshold gate networks. In this method, the error correcting network is designed from the Boolean function to be realized. A primary realization is a realization for some function on the tree such that either the separating function or the gaps are assigned without knowledge of any other realizations on the tree. It is shown that a realization obtained by the tree method will correct t errors of gates in the system if and only if all primary realizations are selected so that they will correct t errors of gates in the primary realization. Relations are then presented for selecting the primary realizations. Dissert. Abstr.

N68-24470# Queens Univ., Kingston (Ontario). Dept. of Mathematics.
AN ERROR STUDY OF NON-LINEAR DEVICES
W. G. S. Hines Jan. 1968 94 p refs
(Contract DRB-CD-713000)
(RR-68-1) CFSTI: $3.00

The stability of results produced by certain analyses, relevant to electrical engineering, when initial assumptions are slightly in error, is investigated. The analyses considered are the determination of the autocorrelation function and of the spectral density of a signal obtained as the response of a given non-linear device, or filter, without memory, to normalized Gaussian noise with known autocorrelation function or spectral density. It is found that the results of the analyses are indeed stable in the sense that the absolute error in either analysis decreases to zero with the error in the assumption about the exact description of the device or of the input signal developed for all cases. To give some indication of the natures of different bounds, error studies are made for two simple non-linear devices, the infinite clipper and the square law device, for an input with autocorrelation function $e^{-|\tau|}$. Several graphs showing various aspects of the studies are presented. Author

N68-24630# Illinois Univ., Urbana. Dept. of Computer Science.
PARTIALLY SEPARABLE FUNCTIONS
Thomas Andrew Slivinski (Ph.D. Thesis) 1 Jun. 1967 111 p refs
(Contract AT(11-1)-1469)
(COO-1469-0061; Rept.-228) CFSTI: HC $3.00/MF $0.65

Threshold logic was the center of much interest in recent years. An extension of the concept of linear separation is presented

to generate a wider class of functions. This generalization is affected by modifying the requirements for separation to allow both true and false assignments to reside on the same hyperplane (pseudo-separation) or within the same neighborhood of a hyperplane (marginal separation). Functions which can be separated in either of these ways are called partially separable functions. Some of the theoretical algebraic properties of partially separable functions are investigated and the relationship between these and the corresponding properties for separable function is explored. Necessary and sufficient conditions for each type of separable, pseudo-separable, or marginally separable is introduced. Integer linear programming algorithms which are guaranteed to minimize the number of true or false assignments on the same hyperplane for pseudo-separation or the number of assignments within the same neighborhood of a hyperplane for marginal separation are presented. A systematic procedure for synthesizing an arbitrary partially separable Boolean function in a network of threshold elements based on these algorithms is developed. Author (NSA)

N68-24701# Weizmann Inst. of Science, Rehovoth (Israel).
ELECTRONICS
E. H. Frei et al *In its* Sci. Activities 1967 [1968] p 129–143 refs (See N68-24697 14-23)

Basic and applied magnetism studies comprised the main effort of electronics research, and the linear dependence of antiferromagnet susceptibility on a magnetic field was found. Moessbauer spectroscopy was demonstrated for use with monochromatic radiation polarized both linearly and circularly; and the narrowing of the Moessbauer lines due to electron hopping was observed in Eu_3S_4. A magnetic contrast material for gastro-intestinal X-ray diagnosis was developed and tested in both animals and humans. An analytic solution is offered for aging of magnetic fields, as was a model for the structure of a Neel wall and the measure of self-consistency in 180 domain wall models. An empirical expression was given for the axial field of cylindrical bar magnets, a capacitive transducer instrument for measuring displacement of the middle ear in animals is reported, and gyrotropic birefringence was considered. Abstracts are presented for a number of other studies, including several that deal with wideband magnetic optical readout and an endocardial radio frequency pacemaker used on dogs. M.W.R.

N68-24783*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RELIABILITY INDICES OF SOME ELEMENTS OF AUTOMATIC SYSTEMS
V. F. Yevstratov and Yu. V. Tul'chinskii Redstone Arsenal, Ala. Redstone Sci. Inform. Center Apr. 1968 13 p Transl. into ENGLISH from Mekhaniz. i Avtomatiz. Proizv. (Moscow), v. 1, 1966 p 43–45 Supported jointly by Army
(NASA-TM-X-61106; RSIC-777) CFSTI: HC $3.00/MF $0.65 CSCL 09C

As various automatic systems find an ever increasing application for calculating the reliability of certain devices, data on the reliability of various elements and parts are cited to show the possibilities of using such information for evaluating the intensity of operational failures. The data concerning the reliability of elements are the results of statistical processing of information obtained by testing an experimental system of automatic control of refrigerating units on a fishing trawler. Author

N68-24908 Maryland Univ., College Park.
THE SYNTHESIS OF REDUNDANT THRESHOLD-LOGIC NETWORKS
Robert Edward Lyons (Ph.D. Thesis) 1966 152 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-2338

The objective of the research reported in this dissertation is to devise synthesis procedures for redundant switching networks comprised of threshold-logic elements. A redundant switching network is defined as one which includes extra elements so that the correct output may be produced in spite of the failure of some of the elements which comprise the network. The research has been limited to the use of the von Neumann multiplexing principle employing networks of threshold-logic elements. This research has been motivated by the requirement for an unmanned-satellite-contained digital system which is required to operate without failure for years in an environment which precludes maintenance. Dissert. Abstr.

N68-24998# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Systems Research Sec.
ON MINIMIZATION OF TRAJECTORY SENSITIVITY
E. Kreindler Mar. 1968 18 p refs Submitted for publication (RE-320J)

This research report explores the engineering potential of incorporating quadratic sensitivity terms in linear optimization problems as a means of sensitivity reduction to plant-parameter deviations in linear feedback control systems. The sensitivity problem is of great practical importance because the parameters entering the mathematical model of the system to be controlled (the plant) are either not exactly known or are subject to change due to various internal and external influences. For example, most of the parameters which enter the equations for airframe dynamics depend on the dynamic pressure. The theoretical part of the investigation is fairly complete but more numerical experimentation is needed to determine whether the complications of the optimization problem augmented by the sensitivity terms are justified by the reduction in sensitivity obtained. It is felt that the method discussed might very well be of value in critical cases, such as the control of the large booster, where even a limited reduction of sensitivity justifies some additional design effort and a somewhat more complicated controller. Author

N68-25026 Texas Univ., Austin.
A STUDY OF HAZARDS IN THRESHOLD NETWORKS
Alfred Bart Howe (Ph.D. Thesis) 1966 124 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-3299

Logic hazards in threshold gate networks are studied. Eichelberger has proved that logic hazards are not present in a sum-of-product (product-of-sum) realization which realizes all of the possible 1(0) prime implicants of the given Boolean function. Logic gates of the AND or NOR (OR or NAND) variety realize single 1(0) prime implicants, therefore, a gate is required for each 1(0) prime implicant to be realized and the problem of eliminating logic hazards is straightforward. A method is first presented for determining if a given threshold realization contains any logic hazards within a particular prime implicant. A procedure is then given for obtaining a realization from the given realization, such that the latter realization will have the same hazard conditions as the given realization. A method is then presented for synthesizing logic hazard free realizations directly from the Boolean function to be realized. This method is based on the tree method for synthesizing threshold gate networks. In the last part a set of algorithms are given for modifying a given realization such that the modified realization will not contain any logic hazards. Dissert. Abstr.

N68-25075 Florida Univ., Gainesville.
MODEL AND IDENTIFICATION THEORY FOR DISCRETE SYSTEMS
Stanley Louis Smith (Ph.D. Thesis) 1966 134 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-3510

The improved performance of recently developed methods for digital simulation is related to certain features of the discretization procedure. These characteristics indicate an approach for the

improvement of other discrete representations. This approach requires the identification of parameters within the discrete model to obtain desired response characteristics. Formulation of a procedure for the parameter identification leads to a two-point boundary-value problem. This problem is resolved via a discrete version of the method of quasi-linearization. A procedure for digital computer implementation of this technique is developed and a number of digital experiments performed. Improved discrete models of continuous systems are shown to be obtained with the technique presented. A discrete formulation for the method of differential approximation is presented and the effectiveness of this approach for parameter identification investigated through a series of computer experiments. Dissert. Abstr.

N68-25083 Pennsylvania Univ., Philadelphia.
THE COMPLEX INTERACTING SAMPLED-DATA CONTROL SYSTEMS OF THE QUADRUPLEX COLOR VIDEO TAPE RECORDER (Q-CVTR) VERSUS CONTROL THEORY
Guthikonda Virbhadra Rao (Ph.D. Thesis) 1966 231 p
Available from Univ. Microfilms: HC $10.60/MF $3.00 Order No. 67-3102

After a brief introduction to color television, the Q-CVTR, and the techniques of analysis and synthesis presently available in control theory, the measure-and-optimize technique used in the laboratory to develop these highly-accurate interacting sampled-data control systems is presented with the aid of waveforms in a few cases. Due emphasis is placed in this control engineering application on the step-by-step compression of the state-space limit-cycle of a multi-dimensional system to a final performance-index of the order of ±2.5 degrees at the color subcarrier frequency 3.58 Mc/s. The amazing figure-of-merit of this adaptive nonlinear control system-complex is a pre-requisite for the faithful reproduction of color from video tape. The underlying theory of control in a set of examples, presented with simple mathematical models, then proves the validity of some of the theoretical assumptions made and conclusions drawn in the measure-and-optimize techniques of analysis and synthesis. Dissert. Abstr.

N68-25229 Michigan Univ., Ann Arbor.
A DISCRETE LINEAR FEEDBACK CONTROL THEORY INVENTORY MODEL
Robert George Sargent (Ph.D. Thesis) 1966 158 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-1797

This dissertation studies the "order up to a given level" inventory model, where this level is variable and is controlled by a linear decision rule and a linear forecaster. This inventory model, which we designate the feedback model, is of the single item, single warehouse, periodic review, backorder type with the additional requirement that a replenishment order is placed each review time to restore the inventory position to this variable level. The model is formulated and analyzed using discrete linear feedback control theory. The feedback decision rule is limited to difference, proportional, and summing control, each with its own weighting (gain) parameter. The model is studied for the cases of no replenishment delay, one period delay, and two period delay, each with three demand processes: (1) independent and identically distributed each period (Poisson and normal), (2) correlated between adjacent periods (normal), and (3) increasing variance with step changes allowed in the mean (normal). Dissert. Abstr.

N68-25233 Texas Univ., Austin.
OPTIMAL STOCHASTIC CONTROL THEORY APPLIED TO INTERPLANETARY GUIDANCE
James Franklin Jordan, Jr. (Ph.D. Thesis) 1966 230 p
Available from Univ. Microfilms: HC $10.35/MF $3.00 Order No. 67-3305

A study is made of the effects of noise in the controls on an optimal deterministic trajectory. The effects are illustrated on the example problem of a continuously thrusting spacecraft on a minimum time Earth-to-Mars transfer trajectory. On the basis of the characteristics of these effects, the decision is made to develop an optimal stochastic control. The control is a nonrandom function of time and is designed apriori to anticipate the expected effects of the noise on the dynamic system. A stochastic calculus of variations approach is employed in order to compute the stochastic control, which essentially guides the expected value of the state to meet the terminal conditions, while extremizing the expected value of the original deterministic performance index functional. The resulting stochastic control is applied to the interplanetary transfer problem. Dissert. Abstr.

N68-25257 Texas A&M Univ., College Station.
INTERACTION IN MULTIVARIABLE SYSTEMS
Robert Lee Young (Ph.D. Thesis) 1966 114 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-268

Interaction in multivariable systems is precisely defined using the P-canonical form. A frequency response of interaction strength that is derived using numerical methods is given to define consistently interaction strength in a usable form. The frequency response is based on the nondiagonal terms of the inverse plant matrix (P^{-1}). A direct relationship between this frequency response of interaction strength and the design of controllers is discussed. A method is given by which a totally interacting plant can be reduced to a plant that is not totally interacting. The dependency between the outputs that caused the plant to be totally interacting can be observed, and the desired output or outputs can be removed. A strongly interacting multivariable plant may be reduced to a less strongly interacting system. The order of the magnitudes of the frequency response of interaction strength between outputs can be found for the entire system. Dissert. Abstr.

N68-25291*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A USE OF LIGHTHILL'S GENERALIZED FUNCTIONS IN THE SOLUTION OF OPTIMAL CONTROL PROBLEMS
Ernest S. Armstrong 1967 10 p refs Presented at the Space Sci. and Technol. Sect., Va. Acad. of Sci., Norfolk, Va., 3-6 May 1967
(NASA-TM-X-60135; L-5696) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Pontryagin's maximum principle is applied to a controllable dynamic system, resulting in a two-point boundary value problem. The manner in which Lighthill's generalized function theory can be used in solving the problem is outlined. An algorithm is briefly described for the problem of rendezvous of a lunar launched space vehicle with a target vehicle in a circular lunar orbit. Basic definitions and properties of Lighthill's formulation are also included. N.E.N.

N68-25368*# Texas Univ., Austin. Dept. of Electrical Engineering.
SOME REMARKS ON THE STABILITY OF TIME-VARYING SYSTEMS
J. K. Aggarwal and E. F. Infante (Brown Univ.) [1967] 11 p refs Prepared jointly with Brown Univ.
(Grant NGR-40-002-015; Contract DA-31-124-ARO(D)-270; Grants AF-AFOSR-693-67; NSF GK-1879)
(NASA-CR-94777) CFSTI: HC $3.00/MF $0.65 CSCL 09C

A large number of results are presently available for the determination of stability conditions for time-varying systems; among these is the well known "circle criterion" and its variants. The object of this note is to discuss through examples some of the results which are of an essentially different nature from the circle criterion. The examples chosen are of second order but they are rather illustrative of some of the advantages and difficulties of the techniques discussed. Author

N68-25436*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
STUDY OF A GLOBAL SEARCH ALGORITHM FOR OPTIMAL CONTROL
Elwood C. Stewart, William P. Kavanaugh, and David H. Brocker [1967] 77 p refs
(NASA-TM-X-60529) CFSTI: HC $3.00/MF $0.65 CSCL 09C

In this paper a feasible method of implementing the Maximum Principle is given based on an adaptive random search algorithm which utilizes direct measurements of the boundary cost-function hyper-surfaces. No restrictions are placed on the continuity of the surfaces or the number of valleys. The adaption enhances convergence by varying the mean and variance of a probability distribution as a function of the past performance. The algorithm has both local and global search properties so that hanging up in local valleys is avoided. A hybrid computer implementation of the algorithm is discussed. The usefulness of the algorithm is investigated experimentally for a fifth-order nonlinear minimum-fuel orbit-transfer problem. Convergence is generally obtained within several thousand iterations (one to two minutes). Author

N68-25439# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
ELECTRONIC LOGIC SYSTEM FOR CONTROL OF THE LINDE LIQUEFIER WITH A CIRCULATING CYCLE [ELEKTRONNAYA LOGICHESKAYA SISTEMA DLYA UPRAVLENIYA DROSSEL'NOI OZHIZHITE'NOI USTANOVKOI S TSIRKU LYATSIONNYM TSIKLOM]
V. F. Sikolenko and V. L. Tishchenko 1968 13 p refs In RUSSIAN Submitted for publication
(JINR-P8-3679)

An electronic logic system for control of the Linde liquefier with a circulating cycle was described. The application of this system allows to automatize the most part of the technological process of gas liquefaction. The similar system of automatic control can be used in other cases requiring regulation of the pressure and the quantities of gas and liquids transferred. Author (NSA)

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N68-24458*# Physics Technology Labs., Inc., La Mesa, Calif.
ADDITIONAL BEAM PARAMETER MEASUREMENTS AND COMPLETION OF AN ATOMIC BEAM SYSTEM Final Report, Jun. 1966–Jul. 1967
Jul. 1967 24 p ref
(Contract NAS5-9357)
(NASA-CR-94689) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A neutral beam apparatus has been built for the purposes of studying the effects of medium energy neutral particles on upper atmospheric sensors and test surfaces. The apparatus consists of an atomic beam source, a source chamber, a velocity selector, a torsion balance and ancillary electronics and pumps. Testing has been carried out and the system was installed at Goddard Space Flight Center. Sputter acceleration studies with oxygen and nitrogen were made for bombardment voltages from 500 volts to 5000 volts. Forces for the total beam flux were obtained of $\approx 10^{-2}$ dynes/cm^2 representing a neutral particle flux of $\approx 10^{17}$ atoms/cm^2 sec. The velocity selected beam measurements indicated that the average particle energy was above the 10^6 cm/sec velocity capability of the selector; however, selected fluxes of monoenergetic beams were obtained with densities of 3 to 8×10^{13} particles/cm^2 sec. Author

N68-24516*# General Electric Co., Pittsfield, Mass. High Voltage Lab.
LIGHTNING PROTECTION GUIDELINE FOR STADAN GROUND EQUIPMENT Final Report
T. J. Blalock Greenbelt, Md. NASA. Goddard Space Flight Center 20 Nov. 1967 96 p refs
(Contract NAS5-10572)
(NASA-CR-94682; S-523-P-8) CFSTI: HC $3.00/MF $0.65 CSCL 14B

An investigation was made of the lightning protection and grounding system at the National Aeronautics and Space Administration's STADAN Data Acquisition Station near Rosman, North Carolina. The station had experienced severe system interruptions due to lightning prior to this investigation. It was felt that the nature of the problems encountered consistuted a threat not only to equipment at the station, but also to the safety of operating personnel. The investigation was initiated for the purpose of providing recommendations as to improvements in the grounding system that would reduce the lightning hazard. These recommendations, and their applicability to other sites of this nature, are described. Author

N68-24560*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A HIGH ENTHALPY PLASMA GENERATOR FOR ENTRY HEATING SIMULATION
Charles E. Shepard, Donald M. Ketner, and John W. Vorreiter Washington May 1968 19 p refs
(NASA-TN-D-4583) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The constricted arc supersonic jet has a variety of applications, the most important probably being the simulation of entry heating from interplanetary missions. Within a constricted arc supersonic jet apparatus, a supersonic nozzle with an elongated throat, or arc constrictor, a direct-current arc and a longitudinal flow of gas are maintained. The working fluid, which may be air or any other gas, is heated as it passes near the arc, becomes electrically conductive and eventually becomes a part of the arc core. The arc core temperature is maintained by current flow while the gas passes through the supersonic nozzle into the test section. At present, total enthalpies and impact pressures corresponding to flight at 10 km/s at 60 km altitude and 30 km/s at 100 km altitude can be achieved. The three major limitations on performance are the maximum wall heat flux that can be removed by the cooling water, the maximum current that can be maintained without electrode erosion and subsequent stream contamination, and the maximum voltage gradient that can be maintained without destructive arc-over. Author

N68-24598# Cambridge Electron Accelerator, Mass.
[ON ELECTRON ACCELERATOR] Semiannual Report, 1 Jan.–30 Jun. 1967
15 Dec. 1967 37 p
(Contract AT(30-1)-2076)
(CEAL-1038) CFSTI: HC $3.00/MF $0.65

Accelerator operation, principal improvements made in the accelerator and in the associated facilities, delivery and assembly of the new 100-MeV linac, the nature of each of the 34 experiments in progress or in preparation, safety, and the steady progress on Project Bypass are reported. Also, the planning of the Sixth International Conference on High Energy Accelerators is discussed. NSA

N68-24603# Joint Publications Research Service, Washington, D. C.
CHARGED PARTICLE ACCELERATORS

A. A. Kolomenskiy, E. G. Komar, and S. M. Rubchi *In its* Soviet Atomic Sci. and Eng. 13 May 1968 p 176–195 (See N68-24602 14-22)

Basic data are presented on the operations and functions of charged particle accelerators, and the work which has been performed in determining the principal characteristics of elementary particles. A comparison is drawn between Soviet and United States technological advances, with mention made of the Soviet 680 MeV synchrocyclotron, the 10 BeV synchrophasotron, and the planned 70 BeV proton accelerator, and the American 3 BeV cosmotron, the 6.2 BeV bevatron, and the 33 BeV synchrophasotron. Details are given on the particular applications of the direct action accelerators, cyclic accelerators, and linear accelerators in high energy physics research. New methods of acceleration, based on the use of electron plasma properties, are also discussed. M.G.J.

N68-24605# Joint Publications Research Service, Washington, D. C.

THE 70 BEV PROTON SYNCHROTRON

Yu. Ado and E. Myae *In its* Soviet Atomic Sci. and Eng. 13 May 1968 p 237-241 (See N68-24602 14-22)

The experimental capacities of the 70-Bev proton synchroton are discussed, and the claim is made that, on its completion, the Soviet accelerator will be the world's most powerful synchrophasotron with strong focusing. The proton energy which can be produced is estimated to be over two times greater than the energy of particles produced by the most powerful foreign accelerators; it is designed to accelerate 10^{12} protons per impulse at a repetition frequency of eight acceleration cycles per minute. Summary data are also included on the systems design and installation. M.G.J.

N68-24606# Joint Publications Research Service, Washington, D. C.

THE HEAVY ION ACCELERATOR

G. N. Vyalov *In its* Soviet Atomic Sci. and Eng. 13 May 1968 p 242–251 (See N68-24602 14-22)

Comparative data are presented on the intensity and energy of beams produced by heavy ion accelerators to point up the superiority of the Soviet cyclotron for accelerating multicharged ions. The cyclotron, which is used to produce beams of heavy ions from boron to argon with A/Z ratios from 3.5 to 7, has also been used to study the reactions between complex nuclei and the experimental synthesis of transuranium elements. Technical details are provided on the ion source, the iron electromagnet for creating the magnetic field, and radio frequency accelerating system, the vacuum system requirements for accelerating the heavy ions, the central area design of the accelerator, and the deflecting system for beam extraction from the vacuum chamber. M.G.J.

N68-24723*# National Aeronautics and Space Administration, Washington, D. C.

WALLOPS STATION, WALLOPS ISLAND, VIRGINIA

1968 4 p

(NASA Facts 0-11/12-67) GPO: HC $0.15; CFSTI: MF $0.65 CSCL 14B

As part of its educational program, NASA has issued a fact sheet on the research being conducted at the Wallops Station rocket launch site. Primary emphasis is placed on gathering information about the earth's atmosphere and its near-space environment, and on obtaining data on the flight characteristics of airplanes, launch vehicles, and spacecraft. An overview is included on the components and systems development experiments, the efforts in support of the national sounding rocket program, and the tracking and data acquisition facilities. M.G.J.

N68-24780# Royal Aircraft Establishment, Farnborough (England).

SPACE ENVIRONMENT SIMULATION FACILITIES AT THE ROYAL AIRCRAFT ESTABLISHMENT

T. N. Williams Jul. 1967 61 p refs

(RAE-TR-67152) CFSTI: HC $3.00/MF $0.65

A range of space environment simulation facilities for testing satellites and their materials and components has been built up at Space Department, R.A.E. These facilities are described, with particular reference to information of interest to a potential user. Author

N68-24784*# National Aeronautics and Space Administration, Washington, D. C.

AMES RESEARCH CENTER, MOFFETT FIELD, CALIFORNIA

1968 4 p

(NASA Facts 0-2/12-67) GPO: HC $0.15; CFSTI: MF $0.65 CSCL 14B

As another in its series of educational publications, NASA has issued a fact sheet on the Ames Research Center, which specializes primarily in theoretical, experimental, and analytical studies pertaining to the life sciences. Management of space flight projects is discussed, and an overview is presented on the work being conducted in the areas of reentry, space sciences, and aeronautics. M.G.J.

N68-24806# Ludwig-Maximilians-Universitat, Munich (West Germany). Meteorologisches Institut.

ACTIVITIES OF THE METEOROLOGICAL INSTITUTE MUNICH IN THE FIELD OF SATELLITE METEOROLOGY AND PHYSICAL PROPERTIES OF ATMOSPHERIC GASES IN CONNECTION WITH SPACE RESEARCH 1965–1967 [AKTIVITAET DES METEOROLOGISCHEN INSTITUTES MUENCHEN AUF DEM GEBIET DER SATELLITENMETEOROLOGIE UND PHYSIKALISCHEN STRAHLUNGSEIGENSCHAFTEN ATMOSPHAERISCHER GASE IM RAHMEN DER WELTRAUMFORSCHUNG 1965–1967]

H.-J. Bolle Feb. 1968 53 p refs In GERMAN; ENGLISH summary

(BMWF-FB-W-68-13) CFSTI: HC $3.00/MF $0.65

The growth of the satellite group of the Meteorological Institute Munich is described, and a survey of the work in progress is given. Author

N68-24818# Aeronautical Research Council (Gt. Brit.).

THE THEORY OF INTERFERENCE EFFECTS ON DYNAMIC MEASUREMENTS IN SLOTTED-WALL TUNNELS AT SUBSONIC SPEEDS AND COMPARISONS WITH EXPERIMENT

H. C. Garner, A. W. Moore, and K. C. Wight London HMSO 1968 61 p refs Supersedes NPL-AERO-1211, ARC-28339, X67-16910

(ARC-R&M-3500; NPL-AERO-1211; ARC-28339) HMSO: £1 6s 6d

The theory explains serious wall interference observed on oscillating half-wings in rectangular tunnels with slotted roof and floor. Numerous comparisons with measured forces illustrate effects of tunnel shape, Mach number, pitching axis and frequency. Damping derivatives, especially lift, are worst affected. Less interference is predicted with complete models; the best theoretical remedy is to have only side-walls slotted. Viscous flow at the slots is discussed empirically. Author (ESRO)

N68-24896# Aeronautical Research Council (Gt. Brit.).

AIR CONDENSATION EFFECTS MEASURED IN THE R.A.E. 7 IN.×7 IN. HYPERSONIC WIND TUNNEL

J. F. W. Crane and R. J. Marshall London HMSO 1968 39 p refs Supersedes RAE-TR-66137, ARC-28139, X67-13736

(ARC-R&M-3511; RAE-TR-66137; ARC-28319) HMSO: 17s 6d

It is important to study the effects of air condensation in hypersonic wind tunnels and to establish the degree of supersaturation achievable because savings in heating requirements or increase in Mach number may be achieved. The degree of supersaturation measured in this tunnel shows that with the present heater the upper limit on Mach number may be extended from M = 9 to M = 12. Proof testing of models is required to establish that results in supersaturated flow agree with those obtained in subsaturated flow because localized condensation effects in expansion regions may occur. Integrated pressure distributions on a Nonweiler wing show that sub and supersaturated flows give similar results but that condensing flow shows differences in c_p on the suction side at low incidence and on the windward side at high incidence, which results in a decrease in L/D_{max} without friction of about 10%. Author

N68-24947# National Gas Turbine Establishment, Pyestock (England).
A CONVERGENT NOZZLE FOR THE STANDARDISATION OF THRUST RIG MEASUREMENTS
M. V. Herbert Jul. 1967 35 p refs
(NGTE-R-293) CFSTI: HC $3.00/MF $0.65

It is shown that an increase of Mach number from approximately 0.2 to 0.4 at entry to a convergent nozzle of specified shape does not appreciably change its performance. Such a nozzle is thus recommended as a standard device for calibrating the air meter on any thrust rig. For more general application as a means of mass flow measurement, a value of discharge coefficient can be taken from this work, provided the flow conditions at entry are reasonably uniform, and excluding high temperatures. Use of that value may be subject to certain corrections, and its absolute accuracy when applied to any nozzle of the same nominal specification may not be better than ±0.3 per cent. Author

N68-24966*# Ling-Temco-Vought, Inc., Anaheim, Calif. LTV Research Center, Western Div.
THE SHOCK EXPANSION TUBE AND ITS APPLICATION AS A SONIC BOOM SIMULATOR
Hugo E. Dahlke, George T. Kantarges, Thomas E. Siddon, and John J. van Houten Washington, D. C. NASA Jun. 1968 46 p refs
(Contract NAS1-5652)
(NASA-CR-1055; TR-0-71200/TTR-125) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The generation of simulated sonic booms by mechanically bursting a pressurized diaphragm in a shock tube and expanding through an acoustic horn is described. An analysis of the expansion tube phenomena is presented, the characteristics of the various wave and wave interactions in the tube-horn combination are established and projected in an x-t diagram. Mathematical expressions for these characteristic wave motions are computed for the expansion tube. The simulator can generate double blast waves with a maximum peak pressure of 27 psf at 10 feet from the horn (on axis) using static pressure of 30 psig. The boom duration is variable from 10 to 600 msec. Subjective data were obtained for quantitative evaluation. Data showing the shape of the blast wave pressure signatures, the radiation pattern on the gound, and blast wave pressure as a function of distance from the simulator are presented. Author

N68-24985# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
STRONG FOCUSSING IN LINEAR ACCELERATORS
H. Wiedemann Jan. 1968 18 p refs
(DESY-68/5)

To focus large emittance positron beams in linear accelerators, both a solenoid field and a FODO channel consisting of a set of quadrupoles with alternating gradients may be used. A thin lens theory for a FODO channel in accelerated particle systems was given by R. H. Helm. The transformation matrices for such a FODO channel consisting of quadrupoles of finite magnetic length are derived. It was found that the thin lens theory gives too optimistic results with respect to the transmitted beam emittance. The deviations from the thin lens theory are shown in diagrams for various parameters. Author (NSA)

N68-24988# Kernforschungszentrum, Karlsruhe, (West Germany). Institut fur Experimentelle Kernphysik.
PROPOSAL TO BUILD A 40 GEV PROTON SYNCHROTRON [VORSCHLAG ZUM BAU EINES 40 GEV PROTONENSYNCHROTRONS]
Jul. 1967 250 p refs In GERMAN
(NP-17274)

A proposal for the construction of a 40 BeV proton synchrotron is presented, which represents a technical and economic variant to other existing and planned accelerators. The proposed synchrotron would have a small magnet aperture, a linear accelerator, and an intermediate synchrotron as injector. The scientific foundations for the design of such an accelerator are given, and the basic conception is outlined. The intensity of the extracted beam is designed as 10^{12} protons/sec. The structure of the accelerator was described by a selection and calculation of parameters which characterize the particle orbit in the principal synchrotron. The building and the radioprotection features are described. A cost estimation is given and a tentative construction plan is presented. NSA

N68-25020 Iowa State Univ. of Science and Technology, Ames.
SIMILITUDE REQUIREMENTS FOR MODELS OF A VORTEX TUBE
Mervin Leroy Smith (Ph.D. Thesis) 1966 56 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-2055

The vortex tube has been the subject of several experimental investigations during the past three decades. The research reported herein is a pioneering effort to initiate a search for design and operating conditions which must be satisfied in order to predict prototype behavior given that of a model. The attempt was to define variables describing characteristic phenomena external of the vortex flow in order to avoid the difficulties associated with measuring internal flow variables. Dimensional analysis was then applied to the selected variables in order to obtain dimensionless ratios (pi terms) which are required by the theory of similitude. Two different sized tubes exhibiting geometrical similarity are reported on here. It is shown that for air flowing these Plexiglas tubes the temperature of the coldflow of the prototype may be predicted from that of the model if the inlet temperature is known, if inlet to cold outlet pressure ratios and flow ratios are modeled and the moisture content of the air flow is similar. Dissert. Abstr.

N68-25055# Sandia Corp., Albuquerque, N. Mex.
THE APPLICATION OF HIGH-SPEED MONORAIL ROCKET SLEDS TO AERODYNAMIC TESTING AT HIGH REYNOLDS NUMBERS
D. J. Rigali and L. V. Feltz [1968] 10 p refs Presented at the 3d AIAA Aerodyn. Testing Conf., San Francisco
(Contract AT(29-1)-789)
(SC-DC-66-1967; CONF-680402-1) CFSTI: HC $3.00/MF $0.65

The use of a monorail rocket-sled system is detailed and recommended as a method of obtaining aerodynamic data in a regime of high Mach and Reynolds numbers. The aerodynamic and mechanical design of the Sandia rocket sleds is described, and the data collection system discussed in detail. The system has been successfully used by Sandia Laboratory to acquire pressure data on cone-cylinders. These data are compared with the data from free-flight rockets, wind-tunnel tests, and computer calculations. A principal advantage of the sled testing method is the high degree

of accuracy possible in determining actual test conditions, which include Mach number, static pressure, and static temperature. Exploratory tests indicate that sleds may be used to collect other types of experimental data such as heat-transfer and boundary-layer transition. The high-speed sled testing technique appears to be the most promising method of simulating flight conditions at low altitudes at Mach numbers up to M–8. To date, excellent data have been obtained at a velocity ever attained by a rocket sled. At this speed, and the Holloman Air Force Base track altitude, the Reynolds number was 42×10^6 per ft, and the dynamic pressure, 55,000 lbs/ft^2. Author (NSA)

N68-25145# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
THE BEAM TRANSPORT SYSTEM FOR THE 300 MEV LINEAR ACCELERATOR [DIE STRAHLFUEHRUNGSSYSTEME FUER DEN 300 MEV LINEARBESCHLEUNIGER]
H. Wiedemann Jan. 1968 57 p refs In GERMAN; ENGLISH summary
(DESY-68/3)

The optics and geometry of the beam transport system between the 300 MeV–Linac and the synchrotron are described, including the beam observation and correction system. In addition, the special systems for positron focussing in the linac are discussed. Author (NSA)

N68-25219*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SUPPORT TO QUALITY AND RELIABILITY ASSURANCE LABORATORY
5 Sep. 1967 87 p refs
(Contract NAS8-21003)
(NASA-CR-61819; LMSC-A842328) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Defined are acceptance and inspection requirements for the seismic pad of the Apollo Telescope Mount (ATM). The ATM alignment verification and dynamic evaluation test setup and procedures are described; the test area for the seismic pad checkout will be enclosed and regulated for isolation from geophysical and cultural disturbances. A graphic illustration of the test setup with seismic pad is included. G.G.

N68-25245*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PILOTED SPACE-FLIGHT SIMULATION AT LANGLEY RESEARCH CENTER
A. W. Vogeley [1966] 50 p refs Presented at the Am. Soc. of Mech. Engr. 1966 Winter Meeting, New York, 27 Nov.–1 Dec. 1966
(NASA-TM-X-59598) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The major manned simulation projects currently underway at Langley, including both aviation and space programs, are outlined. Langley's basic approach and objectives in these programs are described. Those piloted simulation studies having direct applicability to the Gemini and Apollo space programs are reported in detail. Each problem, and the simulation equipment used, is described; and the most interesting study results are presented. Discussions of several simulation problem areas and some general thoughts about the field of manned simulation are presented. Author

N68-25323*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A SYNTHETIC DISPLAY TECHNIQUE FOR COMPUTER-CONTROLLED SIMULATOR AND AIRBORNE DISPLAYS
Jack J. Hatfield [1967] 36 p refs Presented at the USC-NASA Conf. on Manual Control, Los Angeles, 1–3 Mar. 1967
(NASA-TM-X-59640) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The new concept employs the synthetic generation of desired instrumentation at the cockpit interface of the man–machine loop utilizing a programable electronic display system. The synthetic display concept utilized is based on an electronic animation technique which allows the cockpit display designer to proceed directly from static (cardboard) instrument mockups to dynamic displays which are simulated in the cockpit by high resolution closed-circuit monochrome TV. Experimental synthetic display hardware is described from the viewpoint of relating the operational capability and flexibility of the electronic animation technique. The performance achieved to date is illustrated through photographs of synthetically generated electro-mechanical instrumentation. The potential of the technique for synthesizing experimental displays at lower costs, at higher speed, and in new integrated formats is discussed. Author

N68-25451*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
CHECKOUT SYSTEM TRADEOFF STUDY
H. F. Miller 5 Sep. 1967 39 p refs
(Contract NAS8-21003)
(NASA-CR-61818; LMSC-A842331) CFSTI: HC $3.00/MF $0.65 CSCL 22D

Documentation related to two candidate systems under consideration for selection to support factory, thermal vacuum, and Kennedy Space Center (KSC) prelaunch testing of the Apollo Telescope Mount (ATM) is reviewed. Under consideration are the acceptance checkout equipment-spacecraft (ACE-S/C) and manual ground support equipment (GSE) systems. The manual GSE system requires two type of equipment: (1) experiment checkout equipment (ECE), and (2) electrical support equipment (ESE). The ACE-S/C system has been used extensively in all phases of manufacture, checkout, and countdown associated with the Apollo CSM and LEM systems. A comparison of the two systems shows: (1) Cost of a relocated ACE-S/C system is considerably higher than the cost of the manual system. (2) Use of the ACE-S/C system appears possible only if the MSC thermal vacuum chamber is used; however, the manual equipment will enable the use of any of the candidate chambers. (3) Present usage schedule of ACE-S/C systems does not indicate availability of a hardware system to be installed at MSFC in time to support ATM testing. A.L.

N68-25453# California Univ., Berkeley. Lawrence Radiation Lab.
STARTING UP OF BETATRON B-3 WITH EXTERNAL INJECTION
R. G. Bikmatov, A. G. Boriskin, G. B. Glagolev, S. B. Goriachev, V. I. Kudelainen et al Nov. 1967 42 p refs Transl. into ENGLISH from Russian
(UCRL-TRANS-1363) CFSTI: HC $3.00/MF $0.65

The theory of a betatron with electron spiral stacking is described. The question of the beam current limit is discussed from the point of view of intensive beam instabilities. The experiments on the external injection into the betatron with the injection energy 150 and 220 keV are described. The discussion of the results shows that beam current is limited by the parametric resonance of incoherent betatron oscillation. A short review of the known circular beam instabilities in the weak focusing accelerators is given. Author (NSA)

N68-25472# Royal Aircraft Establishment, Bedford (England).
FLIGHT SIMULATION—SOME ASPECTS OF ITS USE FOR STUDIES OF AIRCRAFT HANDLING QUALITIES
D. H. Perry Sep. 1966 25 p refs Presented at the AGARD Flight Mech. Panel's Specialist's Meeting on Stability and Control, Cambridge, Mass., Sep. 1966
(RAE-TM-AERO-952) CFSTI: HC $3.00/MF $0.65

The experience gained during the use of a ground based flight simulator for studying the handling qualities of fixed wing and VTOL aircraft is discussed. The problem of simulator validation is considered, and examples of comparative studies between actual and simulated flight are given. Examples of some recent investigations are used to illustrate the type of original research studies made on the simulator. More general conclusions regarding the use of simulation for handling qualities work are also given. Author

N68-25488# European Organization for Nuclear Research, Geneva (Switzerland). Intersecting Storage Rings Div.
INFLUENCE OF NOISE FROM A HIGH FREQUENCY PROGRAM ON THE STORAGE EFFICIENCY OF THE CESAR [L'INFLUENCE DU BRUIT DE PROGRAMME HF SUR L'EFFICALITE DE STOCKAGE AU CESAR]
A. Brueckner 30 Jan. 1968 48 p refs In FRENCH (CERN-68-3) CFSTI: HC$3.00/MF$0.65

Theoretical and experimental investigations were undertaken to determine the influence of background noise on the particle in an accelerator due to high frequency acceleration, and the storage efficiency of the CESAR (CERN Electron Storage and Accumulation Ring) was studied. Theoretical studies were concerned with approximating the influence of noise on synchrotron oscillations of weak and strong amplitudes; and formulas were found that are considered to have a 5 to 10% error on the total effect of noise. The diffusion model developed during the theoretical studies was confirmed experimentally, and studies were made of white noise, flicker noise, high pass filters, and the noise spectra. Stability zones, use of a scanning bucket, and noise influence on stockpiles were investigated. Transl. by M.W.R.

N68-25512*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ADVANCED COMBINED ENVIRONMENTAL TEST FACILITY
Edward J. Kirchman and Charles J. Arcilesi *In* NRL The Shock and Vibration Bull. Jan. 1968 p 175–192 refs (See N68-25498 14-32) CFSTI: 14B

Presented is a description of the environmental capabilities of a new spacecraft test-facility, the launch phase simulator (LPS), its various subsystems. In addition, operational philosophies and procedures are explained, and spacecraft and component tests conducted to date are summarized. These tests consisted of the simulation of single and combined environments involving the vacuum, acoustic, and steady acceleration systems. Design investigations and research programs used as engineering tools in the design and development of the facility are also dicussed. Finally, future applications and growth potential of the facility are discussed with respect to third generation or advanced mission satellite programs such as the Voyager. Author

N68-25513# Sandia Corp., Albuquerque, N. Mex.
DEVELOPMENT OF SIMULATED AIRCRAFT DELIVERY USING A ROCKET SLED
William R. Kampfe and K. M. Timmerman *In* NRL The Shock and Vibration Bull. Jan. 1968 p 193–201 Supported by AEC (See N68-25498 14-32)

The development of a rocket sled test track facility for conducting tests that simulate aircraft delivery of a variety of systems is reported. The development of this technique grew out of an original requirement that called for the impacting of a weapon system at a low angle onto a horizontal target under closely controlled conditions to permit detailed high speed motion picture photography of the resultant weapon response. Capabilities of the technique and plans for improved trajectory instrumentation are discussed. A photometric ballistic range was installed in conjunction with the rocket sled track for recording trajectory data. A laser tracking system is under development which will replace this ballistic range for more flexible and automated trajectory data gathering. Advantages of simulating aircraft delivery using a rocket sled are: (1) a high degree of ballistic accuracy and repeatability, achievable under the controlled semilaboratory conditions of the rocket sled track; (2) excellent photographic ballistic data obtainable because of accuracy; (3) temperature preconditioning of test units until immediately prior to launch; (4) ease of scheduling; and (5) lower cost. S.C.W.

N68-25533# San Francisco Bay Naval Shipyard, Vallejo, Calif.
DESIGN OF HEAVY WEIGHT SHOCK TEST FACILITIES
Carl G. Schrader *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 85–89 refs (See N68-25525 14-32)

Heavy (6000 to 60,000 lb) Naval shipboard equipment is shock tested on board a floating platform by an underwater explosion. Design objectives and criteria for fixtures and test results are presented. The results suggest that in simple cases the fixture (or foundation) can be designed to be an effective shock reducer. Author

N68-25536# Martin Co., Orlando, Fla.
DEVELOPMENT OF A ZERO-G COAST PHASE AIR GUN
Stanley Rodkin *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 103–110 (See N68-25525 14-32)

The distance measuring switch for a missile required testing in accordance with a unique acceleration-time profile followed by a zero-g coast phase. An air gun was designed and built specifically to carry out these tests. The gun provided variable performance parameters, making it useful also as a accelerator. Although the air gun was designed as a test tool, it serves also for calibrating all distance measuring switches received, since there is no other known facility for calibrating this type of device. Author

N68-25537# Martin Co., Orlando, Fla.
DEVELOPMENT OF A MISSILE LAUNCH SHOCK TEST FACILITY FOR SHILLELAGH
Richard W. Stevens *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 111–115 (See N68-25525 14-32)

The facility described was developed to test Shillelagh antitank missile components in a unique shock and acceleration environment. It is a 96-ft launch tube made from aircraft carrier catapult sections. Test samples, or complete missiles, are mounted in a carrier piston which has hard wire provisions for electrical power, signals from a guidance simulator, and monitoring of subsystem or missile response to guidance command during the simulated launch shock tests. The carrier piston is accelerated by high pressure nitrogen which is released by a specially designed valve which is described in detail. During a 50-msec pulse time (10-msec rise and 40-msec decay), longitudinal acceleration loads greater than 250 g are attained. (The facility has a 600-g capacity.) Terminal velocity for a 250-g shot is 240 fps. A water brake is used to absorb approximately 300,000 ft-lb of kinetic energy from the piston. The facility has been used successfully in Shillelagh pilot lot and reliability confidence tests. Test conditions are repeatable within the limits of accuracy of pressure instrumentation. Recycle time for tests is as low as 30 min. Author

N68-25538# Northrop Corp., Palos Verdes Estates, Calif.
USE OF EXPLODING WIRE APPARATUS FOR LABORATORY SIMULATION OF SHOCK WAVES
Fred B. Safford and Raymond C. Binder (Univ. of Southern Calif., Los Angeles) *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 117–126 refs (See N68-25525 14-32)

The results of an investigation of the potential of the exploding wire for generating shock waves in the laboratory are reported. Previously unavailable information was obtained. Two main features are discussed: the development of apparatus, and the use of this apparatus in particular experiments. The apparatus consists of a power supply, a capacitor storage unit, an explosion chamber for electrodes, ducting for the shock wave, and a termination at the end of the duct. Shock wave velocities, sound pressure levels, and shock front curvature were measured with high intensity microphones. The shock waveform is similar to that measured for nuclear and chemical explosions. The shock wave system has proved to be a reliable, convenient, repeatable, inexpensive, and safe laboratory tool, with the capability of expansion to higher energy yields.

Prediction of peak side-on pressures for a ducted configuration can be made from system parameters. Transmission studies were made with solid plates. The results indicate that transmission loss follows the acoustic mass law with respect to panel weight and frequency, but yields a higher loss because of the transient nature of the disturbance. Exploratory studies of screens (porous barriers) has disclosed substantial transmission loss. While used primarily for shock waves in air, the exploding wire apparatus can also be used for shock waves in water. Author

N68-25539# Army Dept., Washington, D. C. Office of the Chief of Engineers.
NIKE-X SHOCK TUBE FACILITY
Richard G. Donaghy and John J. Healy *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 127–136 refs (See N68-25525 14-32)

A new compressed air shock tube facility is being built to test operating prime movers under simulated air blast conditions. The testing to be performed is in support of the development of power systems for the NIKE-X Anti-Ballistic Missile System. Two shock tubes are provided, one 5.5 ft in diameter and 610 ft long and the other 8.0 ft in diameter and 500 ft long. The performance characteristics of the facility are discussed, along with consideration of the special design problems encountered in the areas of dynamic reactions and stresses, traveling waves in the tube shells, fatigue, and brittle fracture. A summary of the testing to be performed is included. Author

N68-25540# Naval Missile Center, Point Mugu, Calif.
DESIGN AND PERFORMANCE OF DUAL MODE SHOCK MACHINE
W. Douglas Everett *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 137–142 ref (See N68-25525 14-32)

In response to several widely varying shock test requirements, a new shock test machine was built. This somewhat novel machine satisfied all the test requirements by incorporating the following operational features: (1) two modes of operation (drop test and hammer test); (2) portability between several test sites; and (3) flexibility in accommodating test items of widely varying configurations. The machine consists of two dynamic elements: a chain drive test table, and a pneumatically powered anvil-hammer mass. This second element provides a dual test mode capability by functioning as a seismic anvil during drop tests and as an adjustable mass hammer head during hammer tests. In its first year of operation, the machine has performed a variety of military specification and simulated underwater shock tests on specimens as large as a 3000-lb, 14 by 3 by 2 ft shipping container. The dual mode shock machine performance has been highly satisfactory with respect to both shock pulse fidelity and operational reliability. Author

N68-25549# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
HORIZONTAL CRYOSTAT FOR POLARIZED PROTON TARGETS [CRYOSTAT HORIZONTAL POUR CIBLES DE PROTONS POLARISES]
Pierre M. Roubeau (Ph.D. Thesis–Grenoble Univ.) 1967 136 p refs In FRENCH
(CEA-R-3172)

A continuously fed horizontal cryostat to be used for polarized proton targets includes: a standard storage Dewar commercially available; shifting of the Dewar requiring 10 minutes, without any warming of the target; no conventional nitrogen-cooled shield but use of the cold helium vapors evaporated in the transfer line and/or the helium evaporated to cool the polarized crystal; a heat exchanger which reduces by a factor of two the consumption of helium; regulation of the temperature by means of a needle valve included in the superfluid helium line. This cryostat, used in conjunction with a 1000 liters/sec pump allows one to maintain at 1.06°K a target, in which is dissipated 1 watt hyperfrequency power, with a helium consumption of 40 liters/day (measured directly in the storage Dewar). Author (NSA)

N68-25578*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FACTORS INFLUENCING THE CHOICE OF FACILITIES AND TECHNIQUES FOR AERONAUTICAL DEVELOPMENT
Richard E. Kuhn 6 Apr. 1967 40 p refs Presented at Intern. Congr. of Subsonic Aeron., New York, 3–6 Apr. 1967
(NASA-TM-X-59741; L-5476) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Facilities and techniques currently being used in the development of aeronautics are examined. Only a few of the more significant factors are discussed as they relate to technology changes required in this area. It is pointed out that the pace of development of aeronautics in the past has been set by the development of the airplane itself, including those factors arising from interest in V/STOL performance and low speed flight of newer conventional takeoff and landing configurations. In the future, however, operational considerations such as aircraft noise and IFR traffic control will take on increasing significance and the tools for solving the operational problems may become as important as the wind tunnel and flight tests have been in the development of the aircraft. A.L.

N68-25647*# Stanford Research Inst., Menlo Park, Calif.
ANALYTICAL AND EXPERIMENTAL STUDY OF THE "GAS BUFFER" CONCEPT Final Report, 23 Jun. 1967–22 Jan. 1968
John K. Crosby Feb. 1968 20 p refs
(Contract NAS1-7392; SRI Proj. 6726)
(NASA-CR-66624) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Four complete shots using a gas buffer concept were fired without the successful launching of an intact projectile. While one of the four shots was timed incorrectly, cause of failure in the other three was unclear. It was concluded that a continuous piston gun cannot be assembled by previously obtained techniques because the metal tube being collapsed was much longer than those previously studied. The gas between the piston and the projectile does not act as an energy source for the projectile as with a more conventional light gas gun. The gas serves as buffer and helps to even out acceleration peaks that are otherwise too great for the projectile to withstand. If the gas always remained in the buffer zone and did not leak past the projectile, the collapse point, or though any breaks in the tube wall; it could be used during higher and higher velocities without being limited by the properties of the gas itself. Theory of tube collapse and tube expansion are considered, and the configurations and instrumentation for the four shots are given. M.W.R.

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N68-24396# Naval Academy, Annapolis, Md. Dept. of Engineering.
AXISYMMETRIC VISCOUS INTERACTION WITH SMALL SURFACE SLIP AND TRANSVERSE CURVATURE EFFECTS FOR PR = 0.723 AND FOR HELIUM
David F. Rogers Nov. 1967 147 p refs
(E-67-13; AD-667465)

The flow about an unyawed cone is considered for the hypersonic moderately low density regime. The shock wave boundary layer interaction is considered in the context of the hypersonic strong interaction approximation. Small transverse curvature and small surface slip effects are considered as perturbations on the basic strong interaction solution. Solutions of the governing two-point boundary value problem are obtained by reduction to a system of ordinary differential equations using double asymptotic expansions in a slip parameter and a hypersonic transverse curvature parameter which is proportional to M sq. times the Probstein and Elliott transverse curvature parameter. Previous solution for Pr = 1.0, gamma = 1.405 are extended to the cases of Pr = 0.723, gamma = 1.405 and Pr = 1.0, gamma = 1.67. The specific effects of non-unit Prandtl number and increased ratio of specific heats (zeroth-order pressure gradient) on the zeroth-order, first-order slip and first-order transverse curvature induced surface pressure, boundary layer displacement thickness, skin-friction and wall heat transfer rate are discussed. Author (TAB)

N68-24407# New York Univ., N. Y.
SOME OBSERVATIONS ON HETEROGENEOUS MIXING INSIDE CHANNELS
Antonio Ferri and Raymond Edelman Wright-Patterson AFB, Ohio ARL Dec. 1967 43 p
(Contract AF 33(615)-2215)
(NYU-AA-67-109; ARL-67-0274; AD-664593)

The mixing process of two streams produces variation of streamtube areas which affect the choking process. Simple criteria are derived in order to predict the sign of pressure variation as a function of initial conditions. The condition of choking is defined. Numerical examples are presented. Author (TAB)

N68-24436# General Electric Co., Philadelphia, Pa. Missile and Space Div.
THE USE OF THE METHOD OF ACCELERATED SUCCESSIVE REPLACEMENT FOR THE SOLUTION OF BOUNDARY LAYER EQUATIONS
H. G. Lew Jan. 1968 9 p refs
(R68SD8)

The solution of highly nonlinear boundary value problems arising from fluid mechanics has been studied by the method of accelerated successive replacement. It is found that the method is a useful adjunct to other methods such as the shooting and quasi-linearization for the solution of nonlinear differential system with split boundary conditions. Applications to the Falkner–Skan equations are given. Author

N68-24468# Applicazioni e Richerche Scientifiche, Milan (Italy).
STUDIES ON FILM THICKNESS AND VELOCITY DISTRIBUTION OF TWO-PHASE ANNULAR FLOW
L. Biasi, G. C. Clerici, R. Sala, and A. Tozzi Brussels EURATOM Apr. 1967 95 p refs
(Contract EURATOM-106-66-12-TEEI)
(EUR-3765.E; EURAEC-1950) CFSTI: HC $3.00/MF $0.65

This report contains a theoretical study on the fluid dynamics of two-phase annular dispersed flow in adiabatic conditions. Assuming as initial condition a situation of equilibrium, the main quantities necessary for a fully macroscopic description of the system are the total pressure drop, the gaseous and liquid phase distribution and the velocity profiles. Other quantities which are to be determined are the film thickness and the liquid and gas film flow rate. The entrained liquid flow rate and the core gas flow rate can then be obtained by using balance equations. An equation relating the liquid film thickness to the physical and geometrical parameters of the system is obtained. By solving this equation the film thickness and the liquid and gas film flow rates are calculated. The results are compared with experimental data. Author

N68-24551 Maryland Univ., College Park.
TURBULENT MASS TRANSFER IN STIRRED TANKS
Paul Sykes (Ph.D. Thesis) 1966 126 p ref
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-2014

Mass transfer coefficients were determined for 1/8 inch diameter spherical particles suspended in stirred aqueous iodine solutions. Particle density was adjusted to match (5%) the liquid density. The experiments were conducted in a flat bottomed, covered and fully baffled three liter beaker stirred by centrally positioned impellers. The variables studied were: impeller speed (200–600 rpm), system Schmidt number (770–11,300) and impeller type (fan disk turbine, propeller and 45° paddle and turbine). The transfer coefficients for the four impeller types were correlated using the concept of equal coefficients at equal power imputs per unit volume. Overall correlation of the coefficients with the studied variables was attempted using three different particle-liquid relative velocity terms, specifically: the particle terminal velocity, a Kolmogorov turbulent velocity and impeller blade tip velocity. The coefficients were not satisfactorily correlated using the Kolmogorov velocity. Dissert. Abstr.

N68-24562# Mound Lab., Miamisburg, Ohio.
DETERMINATION OF GASEOUS DIFFUSION COEFFICIENTS FROM APPROXIMATE VISCOSITY FORMULAS
S. Weissman 4 Mar. 1968 14 p refs
(Contract AT(33-1)-GEN-53)
(MLM-145) CFSTI: HC $3.00/MF $0.65

The use of approximate formulas for the viscosity of gaseous mixtures to determine diffusion coefficients has two advantages over the use of the rigorous expression. First, the resulting expression for the diffusion coefficient is simpler, and second, the diffusion coefficient can be written solely in terms of experimental quantities and one empirical factor. When the viscosity-derived diffusion coefficients were compared with experimental diffusion coefficients, the Buddenberg–Wilke equation failed if the masses of the components were very different, but the equations proposed by Brokaw and by Francis gave satisfactory results. Author (NSA)

N68-24690 Washington Univ., Seattle.
PLANE COUETTE FLOW BASED ON THE IKENBERRY–TRUESDELL MOMENT EQUATIONS
Heng-chao Chin (Ph.D. Thesis) 1966 119 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-2147

The purpose of this thesis is to study the effect of higher order slip boundary conditions and the validity of Ikenberry–Truesdell formulation of plane Couette flow problem. The equations of motion of Ikenberry–Truesdell are applied to the problem of plane Couette flow with non-linear slip boundary conditions. Analytic and numerical results are obtained when both plates have the same temperature as well as different temperatures. The analysis of truncation number in general and physical parameters in both free molecule and continuum regime shows the following: (1) The third order boundary conditions and the equations of motion are compatible; therefore, they can best represent the fluid motion. (2) The validity of the Ikenberry–Truesdell approximation is inversely proportional to M and Tr, that is, the accuracy of the results decreases as either the Mach number or temperature ratio or both go up. Dissert. Abstr.

N68-24729# National Physical Lab., Teddington (England). Aerodynamics Div.
THE INSENSITIVITY OF TURBULENT FLOW TO CHANGES IN REYNOLDS NUMBER AND MACH NUMBER
P. Bradshaw May 1967 4 p refs
(NPL-AERO-1057) CFSTI: HC $3.00/MF $0.65

Since the effect of viscosity is felt only at the wall, changing the Reynolds number merely changes the inner boundary condition on the turbulent flow (the logarithmic law) and does not directly affect the turbulence, so that any method of boundary-layer calculation that incorporates the logarithmic law should be equally reliable at all Reynolds numbers. Since density fluctuations in a compressible turbulent flow are small compared to the mean density at non-hypersonic Mach numbers, the turbulence, but not the mean flow, should be unaffected, except for the effect on the large eddies of the variation of mean density across the flow. Author

N68-24758*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF LIQUID DEPTH ON LATERAL SLOSHING UNDER WEIGHTLESS CONDITIONS
Jack A. Salzman, Thom A. Coney, and William J. Masica Washington May 1968 18 p refs
(NASA-TN-D-4458) CFSTI: HC $3.00/MF $0.65 CSCL 20D

As a part of the general study of liquid behavior in weightlessness, an experimental drop-tower investigation was conducted to determine the effects of shallow liquid depths on lateral sloshing in a zero Bond number environment. Contact angles were restricted to very near 0°, so that the sloshing equilibrium interface was hemispherical. Cylindrical tanks were tested with both hemispherical and flat bottoms. Natural frequency data were correlated as a function of normalized liquid depth for both tank bottom shapes, and damping data were compared with predictions from high Bond number theory. Author

N68-24825# Sandia Corp., Albuquerque, N. Mex.
SIMILAR SOLUTIONS FOR UNSTEADY ONE DIMENSIONAL FLOW OF A CONDUCTING FLUID WITH POROUS BOUNDARIES
Marshall M. Sluyter Nov. 1967 14 p refs
(SC-RR-67-865) CFSTI: HC $3.00/MF $0.65

Similar solutions are obtained for the Couette flow of an incompressible, electrically conducting fluid under the combined time-dependent actions of a transverse magnetic field and a transverse velocity, i.e., suction or injection, through the boundaries. For the case studies, the magnetic field affects the time scale of the flow, and from a qualitative point of view the problem can be reduced to a viscous-only case. Author (NSA)

N68-24927 California Univ., San Diego.
THE IMPORTANCE OF TOPOGRAPHY IN GENERATION AND PROPAGATION OF INTERNAL WAVES
Helmuth Sandstrom (Ph.D. Thesis) 1966 116 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-1280

The problem of wave motion in stably stratified fluid is studied with the aid of ray theory and by a parallel approach using results from the theory of characteristic curves associated with the general solution to a hyperbolic partial differential equations. It is shown that waves propagate anisotropically with the direction of energy flux fixed by the stability and wave frequency. Because of the anisotropy the waves upon reflection from rigid plane surfaces undergo a change in both wave amplitude and wave number. A characteristic feature of two dimensional propagation with variable depth is the phenomenon of energy flow in bounded beams arising either due to reflection from a sloping boundary or topographic shielding. The tendency of wave motion in presence of sloping bottoms is to become polarized along the streamlines of energy flow. It is further shown that the ray theory solution can be expanded in eigenfunctions, where these exist, but that in applying the radiation condition with normal modes the complex conjugate solution must be considered. Dissert. Abstr.

N68-24931 Maryland Univ., College Park.
ON TIME-DEPENDENT BOUNDARY LAYERS
Jan Raat (Ph.D. Thesis) 1966 144 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-2393

A theoretical analysis of some unsteady viscous flow fields has been carried out. Chapter I deals with the incompressible boundary layer flow, accelerated from rest, over a semi-infinite flat plate. The cases of impulsive motion and uniform acceleration are considered respectively. By employing a momentum-integral technique with carefully chosen velocity profiles, physically meaningful solutions are obtained for these problems. In Chapter II, armed with the insight gained in the previous momentum-integral studies, an investigation is made of accelerated boundary layer flow over slender bodies of revolution, in particular a cylinder. The momentum-integral technique is abandoned in favor of perturbation methods. Solutions are obtained for weak and for strong transverse curvature of the boundary layer. In Chapter III a study is made of the mechanism through which sound is generated by the laminar unsteady viscous motion of a gas. It is found that the periodic velocity field represents a time-dependent energy dissipation, which gives rise to a pressure wave inside the viscous layer adjacent to the wall. The frequency of this pressure wave is twice that of the velocity wave. Dissert. Abstr.

N68-24935 Alabama Univ., University.
NONLINEAR FLUID OSCILLATIONS IN A PARTIALLY FILLED CYLINDRICAL SECTOR CONTAINER
James Adam Baird, Jr. (Ph.D. Thesis) 1966 90 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-1281

This investigation is a study of finite-amplitude free oscillations of an inviscid incompressible fluid in a cylindrical Sector container. The formulation of the problem results in a linear partial differential equation along with three linear boundary conditions and one nonlinear boundary condition. The main difficulty in finding a solution is the satisfaction of this nonlinear boundary condition which must be applied to a moving boundary whose shape is itself unknown. The method of solution is to approximate this boundary condition by a Taylor Series expansion which retains terms to the third order of the wave height. The solution thus found consists of third order approximations for the wave height and natural frequency. Numerical results are presented for the case of a 90° Sector container. These results compare the third order approximation for the wave height to the linear approximation and give the frequency correction factor as a function of depth. Dissert. Abstr.

N68-24936 Virginia Polytechnic Inst., Blacksburg.
SOME ASPECTS OF STRATIFIED FLOW IN CLOSED CONDUITS
Pah-I Chen (Ph.D. Thesis) 1967 56 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-1314

Four investigations of stratified flow were conducted in closed conduits, which included: 1) numerical solution of velocity distribution by using a digital computer, 2) analytical solution and experimental verification of the internal surge wave velocity, 3) experimental observation on the mutual intrusion phenomena, and 4) experimental investigation of the internal hydraulic jump. The equation of motion was derived for the velocity distribution, starting from the Navier-Stokes equations. A special Poisson equation was derived which was then reduced to a Laplace equation by a substitution. This equation was solved by a method of finite differences. Experimental results demonstrated fairly well the energy loss concept in surge wave consideration. A non-antisymmetric property was found during the mutual intrusion. An internal hydraulic jump was created by attaching a damshape barrier on the bottom wall of the pipe. A relation of conjugate depth ratio to the discharge ratio of the two phases was drawn by experimental results. Dissert. Abstr.

N68-24938 Catholic Univ. of America, Washington, D. C.
TURBULENT BOUNDARY-LAYER INDUCED VIBRATIONS OF RIBBONS
Michael Edward McCormick (Ph.D. Thesis) 1966 69 p
Available from Univ. Microfilms: HC $3.80–MF $3.00 Order No. 67-1260

The vibrations of a ribbon excited by turbulent boundary-layer pressure fluctuations are investigated, both analytically and experimentally. The analysis is accomplished by performing a spectral analysis of the randomly excited damped motions of a string. The statistical characteristics of the forcing function are obtained by using an empirical expression for the cross-spectral density of the boundary-layer pressure fluctuations. The experiment was performed by subjecting one side of a stainless steel ribbon to a turbulent boundary-layer in a subsonic wind tunnel. The coincidence effect that was encountered by R. H. Lyon in a similar study is observed. This coincidence effect occurs in the fifth mode of vibration when the free-stream velocity is approximately 1.2 times the wave velocity of the ribbon. This value of the velocity ratio differs from that observed by Lyon. It is believed that the coincidence effect occurs when the convection velocity equals the wave velocity. The agreement between theory and experiment is not good.
Dissert. Abstr.

N68-24940 State Univ. of Iowa, Iowa City.
VELOCITY AND PRESSURE FIELDS OF A DIFFUSING JET
Sedat Sami (Ph.D. Thesis) 1966 108 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-2672

In the flow-establishment region of an air jet issuing with an efflux velocity of about 35 feet per second from a 1.0-foot-diamter nozzle into still air, measurements were made of mean axial and radial velocities, mean static pressure, turbulence intensities, pressure fluctuations and one-point double and triple-velocity correlations. Through use of the measured distributions of mean flow and turbulence characteristics, all terms of the differential and integral forms of the momentum, mean- and turbulence-energy equations were evaluated throughout the region. The results are presented by curves of variation of each of the terms as they appear in the corresponding equations. The pressure field associated with turbulence was seen to show all the characteristics of the velocity field. The two fields were observed to be closely similar in form. At the boundaries of the jet, both the pressure and the velocity fields have exhibited strong intermittency. Dissert. Abstr.

N68-24941 State Univ. of Iowa, Iowa City.
LAMINAR FLOW IN CONDUIT EXPANSIONS
Tin-kan Hung (Ph.D. Thesis) 1966 171 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-2636

This investigation is based on a computational simulation of viscous flow in two-dimensional and axisymmetric conduit expansions of ratio 2:1. The complete Navier–Stokes equations were solved numerically with finite-difference methods in two different manners. In the first, named steady approach, a solution was obtained through calculations based on the vorticity-transport equation without the local acceleration terms. In the second, or unsteady approach, the stationary flow was obtained asymptotically through computations with the equations including the local terms. The steady approach is simpler and consumes less computer time than the unsteady technique for flow with low Reynolds numbers, while the unsteady approach is numerically more stable for larger Reynolds numbers. As a verification of the reliability of the methods, the steady approach was applied for computation of Poiseuille flow; the numerical results converged to the exact solution.
Dissert. Abstr.

N68-25023 Johns Hopkins Univ., Baltimore, Md.
CHARGE GENERATION DURING FLOW OF A HYDROCARBON LIQUID THROUGH MICRO-POROUS MEDIA
John Philip Wagner (Ph.D. Thesis) 1966 124 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-3009

Electric charge generation and transport during flow of a hydrocarbon liquid through micro-porous media (Millipore filters) was investigated experimentally and theoretically. All the filters used had tortuous and/or interconnected pore paths. Charge generation data were correlated by means of dimensional analysis. A theoretical expression for the charge density in the liquid, based on a solution of the nonlinear charge transport partial differential equation for a simplified model of micro-porous media, was developed. The functional form of the charge transfer coefficient was ascertained by means of dimensional analysis. Dissert. Abstr.

N68-25028 Pennsylvania State Univ., University Park.
AN EXPERIMENTAL STUDY OF GRID TURBULENCE IN DILUTE HIGH-POLYMER SOLUTIONS
Andrew George Fabula (Ph.D. Thesis) 1966 314 p
Available from Univ. Microfilms: HC $14.20/MF $4.05 Order No. 67-1920

The aim of this investigation was to contribute to the eventual understanding of the mechanism of frictional drag reduction which occurs with dilute solutions of high molecular-weight, linear polymers in turbulent flows in pipes and in boundary layers. The intention was to measure the effects of the non-Newtonian (visco-elastic) fluid properties of the solutions upon the energy specctrum in approximately isotropic grid turbulence. The longitudinal, one-dimensional spectrum was measured behind a towed grid in a tank filled with water or with dilute aqueous high-polymer solutions. Several types of hot-film anemometers with constant-temperature bridges were used, with emphasis on quartz-coated, platinum-film sensors of conical shape. Cylindrical sensors were found unsuitable because of evidence of coating of the hot-film leading edge. The spectral measurements in water were consistent with wind-tunnel measurements. Dissert. Abstr.

N68-25076 Utah Univ., Salt Lake City.
AN INVESTIGATION OF NONSTEADY FLOW BETWEEN PARALLEL PLATES
Allen Howard Weber (Ph.D. Thesis) 1966 99 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-1203

The numerical solution to the two-dimensional problem of nonsteady fluid flow between two parallel plates is determined. The vorticity transport equation is solved using a variation of a scheme previously developed by Pearson (1964) and Esch (1964). Outflow boundary conditions are modified so that the velocity profile at the exit region depends on the profile at the adjoining column of interior grid points. A channel length of 24 nondimensional units is simulated with grid points every 0.1 nondimensional units. The velocity profile is given for various values of the downstream distance x. The changes in the velocity profile in time are determined. Vorticity values are also determined as they change in time and with downstream distance. Reynolds numbers in this study vary from 0 to 3000. Finite disturbances are introduced at the entrance to the channel and are allowed to propagate a short distance downstream. Velocity profiles and vorticity values resulting from the disturbances are given. Dissert. Abstr.

N68-25110 Michigan State Univ., East Lansing.
AN EXPERIMENTAL STUDY OF THE BOUNDARY LAYER CHARACTERISTICS FOR TWO-PHASE (GAS LIQUID SPRAY) FLOW OVER A CIRCULAR CYLINDER
Harold Eugene Wright (Ph.D. Thesis) 1966 159 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-1702

This research is concerned with the transverse flow of a two-phase (air-water spray) mixture over a right circular cylinder for a range of gas Reynolds numbers from 1×10^4 to 2×10^5, with mass ratios of water to air less than 0.1. The particular area of investigation is the region of the flow field where the boundary-layer separates from the cylinder. Two experimental tools for two-phase boundary layer studies were successfully developed. A technique for measuring the pressure profile was developed, utilizing liquid-filled pressure lines from which a small amount of water is also injected into the liquid boundary layer. Also developed was a method for visually observing the point of boundary-layer separation. The pressure profiles were measured for the case of two phase flow for a gas Reynolds number of 5.64×10^4 and three different water nozzle pressures. Two analytical models were considered: the first assumed a laminar boundary-layer system, while the second considered turbulent flow. Neither analytical model gave good agreement with experimentally-observed separation points. Dissert. Abstr.

N68-25301# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

CONTRIBUTION TO THE STUDY OF GAS PUMPING BY A COLD WALL. MEDIUM ANISOTROPY-WORKING DURATION [CONTRIBUTION A L'ETUDE DU POMPAGE D'UN GAZ PAR UNE PAROI FROIDE. ANISOTROPIE DU MILIEU-DUREE DE FONCTIONNEMENT]

Eric Welby 1968 110 p refs In FRENCH; ENGLISH summary
(ONERA-NT-124) CFSTI: HC $3.00/MF $0.65

Recent developments in space simulation techniques necessitate obtaining enormous pumping rates that can be obtained by condensation of the gases on cryo-cooled walls. Following a survey of the specialized literature, consideration is given to experimental results obtained with a set up of cylindrical geometry and applied the standard calculation of the pumping rate of a cryopump. An interpretation of the various results obtained in the free-molecular domain, is suggested. A direct measurement of the temperature gradient in the condensate leads to the definition of a duration of efficient cryo-pumping. Author

N68-25325*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

RECENT WORK IN FLOW EVALUATION AND TECHNIQUES OF OPERATIONS FOR THE LANGLEY HYPERSONIC NITROGEN FACILITY

Frank L. Clark, James C. Ellison, and Charles B. Johnson 30 Mar. 1967 29 p refs Presented at the 5th Hypervelocity Tech. Symp., Denver, 28–30 Mar. 1967
(NASA-TM-X-59637) CFSTI: HC $3.00/MF $0.65 CSCL 20D

It is the purpose of this paper to discuss the Langley Research Center's Hypersonic Nitrogen Facility and to present some data results which were obtained during its operation. The subjects to be covered are: (1) An overall description of the facility; (2) Mach number survey of the test section; (3) Effect of flow condensation on the measured flow properties in the testing region; (4) Model blockage tests; (5) Pitot pressure survey of the nozzle centerline; and (6) Pitot pressure survey of the nozzle wall boundary layer. Author

N68-25438# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Mechanical Engineering.

EXPERIMENTAL INVESTIGATION OF THE SETTLING OF PARTICLES IN LAMINAR FLOW IN HORIZONTAL TUBING

Clifford A. Wojan, Dennis F. Buono, and James M. Reichman 15 Jan. 1968 36 p refs
(Contract AT(30-1)-3871)
(TID-24285) CFSTI: $3.00/MF $0.65

The settling rate of aerosol particles from a gas in streamline flow in long, straight, horizontal tubes is dependent upon such factors as particle size, volume flow rate, gravitational force, tube length and tube diameter. A change in one of these factors leads to a predictable change in the amount of particles that precipitate from, or settle out of the air flow. It appears that elbows or bends in the tubing affect the amount of particles precipitated. Equations used to predict precipitation rates in straight tubes do not seem satisfactory for tubes containing many bends. Author (NSA)

N68-25473*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SIMULATION AND SCALING OF LOW-GRAVITY SLOSH FREQUENCIES AND DAMPING

Leonard V. Clark and David G. Stephens 13 Sep. 1967 8 p refs Presented at the Space Simulation Symp., Philadelphia, 11–13 Sep. 1967
(NASA-TM-X-60484) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Studied were the simulation parameters important in experimental investigations of low-gravity slosh and the scaling laws important in extrapolating the data to full-scale spacecraft systems. By using relatively small tanks it was possible to amplify the importance of surface tension and viscous forces with respect to gravity or inertia forces, a significant factor in low-gravity slosh with earth-gravity tests. Data were obtained from measurements of the free decay of the fundamental antisymmetric slosh mode in rigid, unbaffled, cylindrical tanks. The data are presented in nondimensional form and examined for dependency on tank size, liquid viscosity, surface tension, and slosh amplitude. Frequency was found to be correlated with and scaled by Bond number, a nondimensional parameter involving surface tension and gravity forces. Damping, however, was found to be dependent upon both surface tension and viscosity under simulated low-gravity conditions and correlated by a combination of Bond number and Galileo number, the latter being a nondimensional parameter involving viscous and gravity forces. The results demonstrate that for low-gravity conditions, slosh damping is relatively high and natural frequency is relatively low, the net result being a marked increase in the time required to settle or damp any slosh motion. Author

N68-25595 California Inst. of Tech., Pasadena.

SUPERFLUID DRAG IN HELIUM 2

John Philip Andelin, Jr. (Ph.D. Thesis) 1967 91 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-432

The drag on a 1.21 millimeter diameter sphere due to flowing superfluid helium II was measured at 1.6°K, 1.8°K, 2.0°K and 2.13°K in a "superfluid wind tunnel" test region 3 cm long and 1 cm diameter) in which 500 A Millipore was used as the barrier to normal component flow for the first experiments, and 100 A Millipore for the later ones. The superfluid flow through the tunnel was much steadier than it was in similar tunnels used in previous experiments. The velocity of the superfluid was calculated from a measurement of the loss rate of liquid helium in a standpipe at the entrance to the tunnel. After corrections were made for a backflow of normal component which leaked through the Millipore, the results were as follows: Within the experimental error, zero drag was often observed for superfluid velocities up to 0.21 cm/sec at 1.6°K, 0.48 cm/sec at 1.8°K, 1.1 cm/sec at 2.0°K and 4.4 cm/sec at 2.0 at 2.0°K and 4.4 cm/sec at 2.13°K. Dissert Abstr.

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N68-24352# Bureau of Mines, Washington, D. C.
MAGNETIC SUSCEPTIBILITY OF COPPER-, LEAD-, AND ZINC-BEARING MINERALS
Howard E. Powell and Lee N. Ballard Jun. 1968 15 p refs (BM-IC-8383)

The magnetic susceptibility, the geographical source, and associated minerals are given for 44 copper-, 26 lead-, and 19 zinc-bearing minerals. Of the 44 copper minerals, all had a susceptibility of less than 15×10^{-6} cgs, and about 20 percent of them were diamagnetic. Of the 26 lead minerals, all had a susceptibility of less than 11×10^{-6} cgs, and almost half of them were diamagnetic. Of the 19 zinc minerals, all except four had a susceptibility of less than 9×10^{-6} cgs, and about one-fourth of them were diamagnetic. Author

N68-24375# Office of Naval Intelligence, Washington, D. C.
THE GEOGRAPHICAL OBSERVATIONS IN THE ANTARCTIC OF THE EXPEDITIONS OF COOK, 1772–1775, AND BELLINGSHAUSEN–LAZAREV, 1819–1821 [GEOGRAFICHESKIYE NABLYUDENIYA V ANTARKTIDE EKSPEDITSIY KUKA 1772–1775 GG.I BELLINGSGAUZENA–LAZAREVA 1819–1821 GG.]
V. L. Lebedev 7 Mar. 1968 42 p refs Transl. into ENGLISH from the Russian Report
(NIC-TRANS-2542; AD-667288)

The report discusses the geographical observations in the Antarctic of the expeditions of Cook, 1772-1775, and Bellingshausen-Lazarev, 1819-1821. TAB

N68-24377# Office of Naval Intelligence, Washington, D. C.
PROSPECTS OF GEOLOGICAL INVESTIGATIONS IN THE ANTARCTIC IN 1960–1965 [PERSPEKTIVY GEOLOGICHESKIKH ISSLEDOVANIY V ANTARKTIDE V 1960–1965 G.G.]
M. G. Ravich 7 Mar. 1968 23 p Transl. into ENGLISH from the Russian Report
(NIC-TRANS-2540; AD-667286)

During the past three years Soviet geologists have carried out an exploratory survey of individual territories along the coast of eastern Antarctica. Only brief reconnaissances were carried out at the majority of locations and areawide geological surveys. Author (TAB)

N68-24380*# Office of Naval Intelligence, Washington, D. C.
THE GEOLOGICAL STRUCTURE OF THE ANTARCTIC PENINSULA AND ALEXANDER I LAND [GEOLOGICHESKAYA STRUKTURA ANTARKTICHESKOGO POLUOSTROVA I ZEMLI ALEKSANDRA I]
G. R. Grikurov 15 Mar. 1968 13 p refs Transl. into ENGLISH from the Russian Report
(NIC-TRANS-2560; AD-667293) CSCL 08G

As a result of the research carried out new material was obtained on the geology of this region which joins South America with the Antarctic continent and which is of interest both from the geographical and geological point of view. Author

N68-24382# Office of Naval Intelligence, Washington, D. C.
RESULTS OF GEOPHYSICAL INVESTIGATIONS OF THE STRUCTURE OF THE EARTH'S CRUST IN ANTARCTICA [RESUL'TATY GEOFIZICHESKIKH ISSLEDOVANIY STROYENIYA ZEMNOY KORY V ANTARKTIDE]
S. A. Ushakov 7 Mar. 1968 31 p refs Transl. into ENGLISH from the Russian Report
(NIC-TRANS-2541; AD-667287)

The report presents the results of investigations of the structure of the earths crust in Antarctica. Conclusions have been drawn principally on the basis of gravimetric data. Author (TAB)

N68-24394*# Aztec School of Languages, Acton, Mass.
PECULIARITIES OF AURORAL RADAR REFLECTIONS AND THEIR CONNECTION WITH THE MAIN GEOMAGNETIC FIELD AND IONOSPHERIC CURRENTS [OCOBENNOSTI AVRORAL'NYKH RADIOOTRAZHENIY I SVYAZ' IKH S POSTOYANNYM MAGNITNYM POLEM I IONOSPHERNYMI TOKAMI]
B. A. Bagaryatskiy and Ya. I. Feldshteyn Washington NASA May 1968 70 p refs Transl. into ENGLISH of Sect. 4 of the IGY Program, Aurora, no. 12, Acad. of Sci. USSR, Sov. Geophys. Comm., Moscow, 1965 p 1–60
(Contract NASw-1692)
(NASA-TT-F-11650) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Spatial and time characteristics of azimuthal distribution of aurora reflections in the frequency range of one meter were studied in this paper based on radar reflection data from stations in the Northern Hemisphere. The azimuth preferences of these stations were compared with the direction of the magnetic field at the Earth's surface. Chapman's concept of a mirror-like, or orthogonal, reflection is taken as the starting point for a theoretical analysis. The structure of the real magnetic field of the Earth is calculated in order to interpret the results of the radar observations. Geomagnetic conditions for reflection and their connection with the structure of the constant magnetic field in the subarctic and arctic regions are analyzed. In the majority of cases, a symmetry was found to exist in the formation of preferred reflection zones relative to the direction of the real magnetic field. The most significant divergences from this rule involve stations located close to the center of the east Siberian anomaly of the vertical component (Tixie Bay, Yakutsk). K.W.

N68-24410*# National Aeronautics and Space Administration, Washington, D. C.
AURORAE AND AIRGLOW [POLYARNYYE SIYANIYA I SVECHENIYE NOCHNOGO NEBA]
V. I. Krasovskiy May 1968 93 p refs Transl. into ENGLISH of Sect. 4 of the IGY Program, no. 11, Acad. of Sci. USSR, Sov. Geophys. Comm., Moscow, 1965 p 1–76
(NASA-TT-F-11649) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Spatial and time variations of the integral continuum spectral distribution for the regions λ5700 Å and λ5300 Å have been obtained from scanning photometer observations. The limits of the variations are from −24% to +9% of the mean value. The integral continuum atmospheric and extra-atmospheric components have different spectral distribution. Author

N68-24453# Kiruna Geophysical Observatory (Sweden).
PCA EVENTS OBSERVED AT KIRUNA IN THE YEARS 1965 AND 1966. DATA COLLOCATION
[1967] 48 p *Its* Suppl. No. 67-1 CFSTI: HC $3.00/MF $0.65

Polar Cap Aborption (PCA) events observed at Sweden's Kiruna Geophysical Observatory during 1965 and 1966 are treated in detail. Riometer tables and collocation figures are included for the five events that occurred February 3–11, 1965; March 22–30, 1966; July 6–13, 1966; August 26–September 1, 1966; and September 2–6, 1966. Solar flare data and Kp-index are given for each; and fixed frequency vertical soundings at 3.0 MHz, critical frequencies, VLF recordings, auroral reflections are considered. Maximum and minimum values for each hour are shown, and earth potential maximum values derived from the north-south component are presented. These earth current recordings show the same behavior as the geomagnetic recordings, although maximum intensity could not be measured because the recorder was saturated at 780 mV/km. M.W.R.

N68-24467# Madrid Univ. (Spain). Facultad de Ciencias.
NEW CONTRIBUTION TO THE STUDY OF THE GEODESY GRID OF THE FIRST SPANISH SYSTEM AND ITS COMPARISON WITH THE COMPENSATORY GRID OF THE EUROPEAN SYSTEM [NEUVA APORTACION AL ESTUDIO DE LA RED GEODESICA DE PRIMER ORDEN ESPANOLA Y SU COMPARACION CON LA RED COMPENSADA DEL SISTEMA EUROPEO]
Fernando Martin Asin 1966 27 p refs In SPANISH Submitted for publication
(Publ.-57) CFSTI: HC $3.00/MF $0.65

A statistical study was previously made of the coordinates of the vertices of the triangulation of the Spanish first order. Formulas were derived in which corrections were obtained in longitude and latitude that could be added to the coordinates of the Spanish grid in order to obtain the corresponding coordinates of every vertix of the European grid. The possible causes of the unhomogeneous distribution of differences in longitude and latitude were not studied but they were believed to be due to gravity anomalies, selection of reference ellipsoid, vertical deviation, and topo-isostatic reductions. This work attempts to verify the causes of these nonhomogeneous distributions. A comparative study is made of various published works in which all the above-mentioned causes are eliminated. A more detailed study of the problem was made with the help of the IBM 1620. The formulas and calculations used to obtain the differences in longitude and latitude to be added to the corresponding geographical coordinates of every vertix to match the same coordinates of the European system are given.
Transl. by R.N.A.

N68-24478# AVCO Corp., Lowell, Mass. Space Systems Div.
THE ANTARCTIC IONOSPHERE. PART A: SURVEY AND BASIC INFORMATION
Rudolf Penndorf Apr. 1968 98 p refs *Its* Antarctic Res. and Data Analysis Sci. Rept. No. 28
(Contract NSF C-515)
(AVSSD-0053-68-CR)

A general survey of the Antarctic ionosphere is given. It is based on the investigation of data collected since the beginning of the IGY, supplemented extensively by results published by other investigators. The first part contains the necessary basic information, followed by a survey of the climate of the ionosphere, i.e. the average conditions, and finally the dynamics of the ionosphere, i.e. the disturbed conditions. A general description of the upper atmosphere is given; the methods of exploring the ionosphere are briefly outlined; the station parameters, equipment, and data are listed. Samples of data and an extensive number of graphical representations of data are given.
Author

N68-24479# Office of Naval Intelligence, Washington, D. C. Translation Div.
TOPOGRAPHY OF THE ANTARCTIC ICECAP AND ITS SUBGLACIAL BED [TOPOGRAFIYA LEDNIKOVOGO POKROVA ANTARKTIDY I EGO PODLYEDNOGO LOZHA]
A. P. Kapitsa 15 Mar. 1968 23 p Transl. into ENGLISH from Inform. Bull. Soviet Antarctic Expedition (USSR), No. 58, 1966 p 5–12
(ONIC-TRANS-2561; AD-667299)

Exploration of the topography of the antarctic ice cap began 15 years ago during the Norwegian-British-Swedish expedition and the French polar expedition in 1950. During the last ten years the expeditions of the USSR, USA, Great Britain, Australia, France, Japan and Belgium carried out significant project in the Antarctic for obtaining data about the topography of the ice caps surface and the thickness of the ice. By 1965 48 thousand kilometers of sections were made. Measurements of the ice caps heights were taken over vast areas by way of airplane radio barometric surveys.
Author (TAB)

N68-24525# Coast Guard, Washington, D. C. Oceanographic Unit.
OCEANOGRAPHIC OBSERVATIONS, NORTH ATLANTIC OCEAN STATION BRAVO 56° 30'N., 51° 00' W., AUGUST 1964–AUGUST 1965
David M. Husby May 1967 124 p refs
(CG-373-9; AD-667637)

The report contains the observed and interpolated temperature and salinity data plus the computed sigma-t, geopotential anomalies and sound velocites for the 73 oceanographic stations taken by seven U. S. Coast Guard Cutters occupying Ocean Station BRAVO (centered at 56 deg 30 min N., 51 deg 00 min W.) during August 1964 - August 1965. They were the USCGC COOK INLET, 4-18 August 1964; USCGC BIBB, 1-14 December 1964; USCGC CASCO, 7-28 January 1965; USCGC CASTLE ROCK 24 February-10 March 1965; USCGC YAKUTAT, 2-23 April 1965; USCGC HUMBOLDT, 13 May-2 June 1965; USCGC COOK INLET, 27 June-14 July; and USCGC ESCANABA, 7-23 August 1965. Oceanographic casts of 13-14 Nansen bottles were made to 1500 meters on alternate days when weather conditions permitted. In addition, sampling was successfully extended to near the bottom on at least one station during each patrol.
Author (TAB)

N68-24530# Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 180
22 May 1968 190 p refs Transl. into ENGLISH from Russian
(JPRS-45446) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. ASTRONOMY p 1–8 refs (See N68-24531 14-30)
2. METEOROLOGY p 9–57 refs (See N68-24532 14-20)
3. OCEANOGRAPHY p 58–80 refs (See N68-24533 14-13)
4. TERRESTRIAL GEOPHYSICS p 81–134 refs (See N68-24534 14-13)
5. UPPER ATMOSPHERE AND SPACE RESEARCH p 135–175 refs (See N68-24535 14-13)
6. MISCELLANEOUS p 176–179 refs (See N68-24535 14-13)

N68-24533# Joint Publications Research Service, Washington, D. C.
OCEANOGRAPHY
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 180 22 May 1968 p 58–80 refs (See N68-24530 14-13)

News items and abstracts of scientific articles on oceanography are taken from the Soviet-bloc literature. Mineral resources of the ocean, underwater laboratories, oceanographic vessels, instrumentation, deep sea photography, and economic aspects of oceanography are covered by the new items. Abstracts deal with topics such as icebergs, diatoms and plankton, convection depth, and ocean water temperature. Models and other techniques for studying the ocean and turbulence are reported; as are studies on ocean sediments, water temperature and content, and information coding and statistical techniques applicable to oceanography.
M.W.R.

N68-24534# Joint Publications Research Service, Washington, D. C.
TERRESTRIAL GEOPHYSICS
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 180 22 May 1968 p 81–134 refs (See N68-24530 14-13)

Terrestrial geophysics news and scientific advances in the Soviet bloc are reported. News items deal with processing magnetograms, mapping and seismograph use, the Salyany

earthquake, and equipment and instrumentation. Earthquake observations and seismic properties, paleomagnetism and geomagnetic drift, glaciation, and crustal deformation are among the topics of abstracts. Attention is given to Moho relief, permafrost, magnetic fields, crustal structure, tectonic structure, and wave propagation in various regions of the Soviet Union. Means of carrying out seismic investigations and computation of various topographic properties are covered; and various statistical and other procedures applicable to terrestrial geophysics are included. M.W.R.

N68-24535# Joint Publications Research Service, Washington, D. C.
UPPER ATMOSPHERE AND SPACE RESEARCH
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 180 22 May 1968 p 135–175 refs (See N68-24530 14-13)

Upper atmosphere and space research activities in the Soviet Union are reported in a variety of news items and abstracts of scientific articles from the open literature. General commentaries on space research and its accomplishments and future are included; along with some book reviews, instrumentation used, cooperative space endeavors, actual Soviet flights, and a comparison of space accomplishments by the United States and the Soviet Union. Abstracts of research articles deal with electron concentration and other observations made of the upper atmosphere, cosmic radiation and magnetic disturbances in space, and electromagnetic wave propagation, and satellite motion. Helium lines in the lower chromosphere, the ozone-eclipse effect, translational-rotational motion, weightlessness and artificial gravity, and photogrammetric applications are also covered. M.W.R.

N68-24536# Joint Publications Research Service, Washington, D. C.
MISCELLANEOUS
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 180 22 May 1968 p 176–179 refs (See N68-24530 14-13)

Miscellaneous news items taken from the Soviet press deal with the international aspect of an Antarctic expedition, two "north pole" Arctic drifting stations, and the establishment of a new Antarctic station. Estimates of ground and surface water resources are reported, and the ground water of Yakutia is discussed as a water resource. Mention is made of a permafrost-hydrogeological map of Yakutia and the photointerpretation of Northern Kazakhstan. Soviet artificial lunar satellites are also discussed. M.W.R.

N68-24549# Weapons Research Establishment, Salisbury (Australia).
IONOSPHERIC DATA FOR APRIL 1967 FROM SALISBURY, SOUTH AUSTRALIA
Aug. 1967 24 p
(WRE-CPD-1967/4/S)

Ionospheric data obtained at Salisbury, South Australia, during April 1967 are tabulated for each hour of each day during the month. The ionosonde used is a modified Cossor portable ionospheric recorder with a frequency range of 1.6 to 20.0 MHz and height range up to 800 km. M.W.R.

N68-24568# Kakioka Magnetic Observatory (Japan).
GEOMAGNETIC OBSERVATIONS AT MEMAMBETSU, JAPAN IN 1962
1968 125 p
(Rept.-52) CFSTI: HC $3.00/MF $0.65

Geomagnetic observations made at the Memambetsu Magnetic Observatory in Japan during 1962 are presented in graphical and tabular forms. Hourly values of magnetic declination, horizontal intensity, and vertical intensity are given; and mean hourly values of magnetic elements are shown for all days, calm days, and disturbed days as well as for the north and west components. General character of the principal magnetic disturbances are included, as are 61 reproductions of magnetograms taken in 1962. M.W.R.

N68-24569# International Geophysical Year World Data Center A, Washington, D. C. Coordination Office.
CATALOGUE OF DATA IN WORLD DATA CENTER A: AIRGLOW, IONOSPHERE, AURORA (INSTRUMENTAL), AURORA (VISUAL), COSMIC RAYS, GEOMAGNETISM, SOLAR ACTIVITY, 1 JULY 1957–31 DECEMBER 1967
Feb. 1968 146 p Supported by NSF

Data on upper atmosphere geophysics, auroras, and geomagnetism received by the World Data Center A between July 1, 1957, and December 31, 1967, are catalogued. Solar activity data are given for 1964 through 1967; while airglow, aurora, cosmic ray, geomagnetism, and ionosphere data cover the entire period. World maps indicate the location of the airglow and solar activity observatories and the all-sky camera, neutron monitor, and vertical soundings stations. Exact locations of all the geomagnetic observatories are given. Both samples of ionospheric data and ground-based data summaries are included along with the yearly listings for 1964 through 1967 and topside soundings. M.W.R.

N68-24592# Kakioka Magnetic Observatory (Japan)
GEOMAGNETIC OBSERVATIONS AT KAKIOKA, JAPAN IN 1963
1967 120 p refs CFSTI: $3.00

This report is one of a series presenting the results of geomagnetic observations carried out by the Kakioka Magnetic Observatory. The Kakioka Magnetic Observatory has been carrying out geomagnetic works as the national standard magnetic observatory of Japan. In addition to these works some observations on geoelectricity, sun-spot, seismology and meteorology are carried out there. Author

N68-24616# RAND Corp., Santa Monica, Calif.
A METHOD OF OBJECTIVE CONTOUR CONSTRUCTION
F. W. Murray Feb. 1968 32 p
(Contract N00014-67-C-0101)
(RM-5564-NRL; AD-666830)

Problems of graphical display of a dependent variable as a function of two independent variables are discussed. A procedure for objective construction of contours is described, and the program logic is presented. Examples of contours of fields developed by a cumulus dynamics program and produced by a General Dynamics S-C4060 are shown. Author (TAB)

N68-24623# Avco Corp., Lowell, Mass. Missiles, Space and Electronics Group.
THE ANTARCTIC IONOSPHERE. PART B: LOWER IONOSPHERE (D REGION)
Rudolf Penndorf Mar. 1968 97 p refs
(Contract NSF C-515)
(AVSSD-0054-68-CR; SR-29)

A review of pertinent knowledge about the D region over Antarctica is given with emphasis on experimental data. The large amount of data and results of relevant investigations are put into logical order, presented, and interpreted. Since precipitating electrons and energetic solar protons are the most important sources of ionization, their spectra, pitch-angle distribution, and fluxes as measured by rockets and satellites are extensively reported. This is followed by computations of the production of ion–electron pairs for such fluxes as function of altitude which indicate the importance of these sources for D-region phenomena over polar regions. Absorption of RF energy is extensively described, especially the so-called auroral absorption. There exist two main types (discrete

and diffuse) which exhibit different time and latitude dependence, are connected with other atmospheric phenomena, and are caused by either splash or drizzle type precipitating electron fluxes. Conjugate events as well as polar cap absorption events and blackout are also discussed. Author

N68-24763*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FEASIBILITY OF DETERMINING ATMOSPHERIC OZONE FROM OUTGOING INFRARED ENERGY
C. Prabhakara May 1968 30 p refs
(NASA-TM-X-63218; X-622-68-203) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The high resolution (5 cm^{-1}) measurements of the outgoing infrared energy in the region of the 9.6μ ozone band offer a means of determining the vertical distribution and total amount of ozone in the earth's atmosphere. With the application of radiative transfer theory and perturbation technique a method is developed to deduce such information. The method hinges on a two parametric representation of the ozone distribution in the earth's atmosphere. An error analysis based on four case studies is presented to show how well the atmospheric ozone could be determined. It is found that a small error in radiance value is magnified considerably in the inferred atmospheric ozone. Author

N68-24773*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
THE INTENSITY DISTRIBUTION IN THE OH(7-2) BAND OF THE AIRGLOW SPECTRUM [O RASPREDELENII INTENSIVNOSTI V POLOSE OH(7-2) SPEKTRA SVECHENIYA NOCHNOGO NEBA]
L. M. Fishkova Washington NASA Apr. 1968 9 p refs Transl. into ENGLISH from Bull. of the Abastumai Astrophys. Lab., No. 34, 1966 p 55–62
(Contract NASw-1692)
(NASA-TT-F-11571) CSCL 04A

Data on the absolute intensity distribution in the OH(7-2) band of airglow spectrum, its variations and absorption in lower atmosphere O_2 and H_2O are obtained on the basis of spectrographic observations. Author

N68-24831*# Aztec School of Languages, Inc., Action, Mass. Research Translation Div.
MAGNETIC SURVEY OF OCEANS: GEOMAGNETISM
M. M. Ivanov Washington NASA May 1968 247 p refs Transl. into ENGLISH of the publ. "Magnitnaya Cyemka Okeanov: Geomagnetism" Moscow, Nauka Press, 1966 p 1–184 Acad. Sci. USSR Rept. No. 7
(Contract NASw-1692)
(NASA-TT-F-11471) CFSTI: HC $3.00/MF $0.65 CSCL 08N

This historical review of the development of magnetic observations on the oceans also describes the first Soviet nonmagnetic ship, the Zarya, and discusses the results of magnetic observations on the oceans during the IGY. The results are interpreted in terms of general magnetic cartography, distribution of geomagnetic field variations on the oceans, and application possibilities for the study of the ocean bottoms. The paper is intended for geophysicists, especially for geophysical magnetologists interested in magnetic cartography and in the geomagnetic variations. The paper is also useful as a guide for evaluating results of magnetic observations over extensive areas and for obtaining continuous magnetic measurements from moving objects. K.W.

N68-24833# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
GEOPHYSICS AND SPACE DATA BULLETIN, VOLUME 4, NO. 4
Anne L. Carrigan, ed. and Norman J. Oliver, ed. 1967 233 p
(AD-667807)

AFCRL contract and inhouse data reported from throughout the world are tabulated. The following types of data are included: Total field intensity magnetometer; Cosmic ray neutron intensity monitor; Extremely low frequency noise; Riometer; Solar optical patrol observations; Solar radio emission (Spectral observations, Radio noise measurements, Radio map - 8.6 mm); Vertical incidence ionospheric soundings (Absorption loss, Median values, Median curves and hourly values); Cumulative index for data published in Geophysics and Space Data Bulletin). TAB

N68-24849 California Univ., San Diego.
WAVE–WAVE SCATTERING FOR GRAVITY WAVES AND ROSSBY WAVES
Kern Ellsworth Kenyon (Ph.D. Thesis) 1968 103 p Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-2741

We apply a theory of weak wave–wave interactions to a gravity wave field in the ocean and a Rossby wave field wave field in the atmosphere. We give a computation f in the atmosphere. We give a computation of an energy transfer rate using temperature observations in the deep ocean as initial information, which indicate that wave-wave scattering among internal waves may partly explain the monotonic decrease from tidal to higher frequencies of spectra of temperature fluctuations in the deep ocean. A computation using temperature measurements in shallow water suggests that wave-wave scattering for initial waves may be most important in the ocean in the shallow water over the continental shelves and near the coasts. We give a computation of scattering of swell energy into internal wave energy from which we conclude that this process may be generally less important for the overall energy balance of internal waves in the ocean than the mutual interactions of internal waves. We compute energy transfer rates for observed values of the geostrophic wind in the atmosphere which show the interactions are quite strong, and we conjecture that wave-wave scattering for Rossby waves may be important for the energy balance of the long atmospheric waves. Dissert. Abstr.

N68-24916* Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
SATELLITE-PLASMA INTERACTION MANUAL
V. C. Liu May 1968 100 p refs
(Grant NsG-660)
(NASA-CR-94792) CFSTI: $3.00 CSCL 04A

A user's manual is presented that provides information charts on flow field syntheses for given geometrical configurations under various ambient conditions. A superposition of appropriate basic flow fields with mutual interference values can be used to estimate the disturbance induced by an orbiting satellite upon the atmosphere. Considered are body parameters that characterize the surface potential, size, speed, and etc. of the moving object. Enclosed tables provide property data of the upper ionosphere and of typical satellites. G.G.

N68-24929 Washington Univ., Seattle.
EXPERIMENTAL INVESTIGATION OF THE TURBULENCE STRUCTURE IN THE LOWER ATMOSPHERE
Charles Edwin Elderkin (Ph.D. Thesis) 1966 198 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-2151

Measurements of turbulence in all three components of the wind were made at several heights, in neutral, unstable, and stable conditions, and in a variety of wind speeds. The data

were analyzed on an analog computer for power spectral density distributions, cospectral density distributions and Reynolds' stresses. Similarity of the power spectral distributions was observed for each of the components with some notable deviations. The spectra for the vertical component measured at 12 meters and above, where bouyancy becomes effective, demonstrated definite convective energy peaks. These occurred in addition to the mechanical energy peaks which corresponded in the normalized spectral distributions to those for the tests close to the ground where mechanical energy dominated the structure. A shift to higher wave numbers was detected for stable cases in the spectra for all three components. The shift was most noticeable at 12 meters where greater stabilities were more possible than close to the ground. Dissert. Abstr.

N68-24944*# Scripta Technica, Inc., Washington, D. C.
THEORY AND CLASSIFICATION OF ERUPTIVE VOLCANIC EVENTS [ZUR THEORIE UND KLASSIFIKATION DER ERUPTIVEN VULKANISCHEN VORGAENGE]
R. A. Sonder NASA May 1968 33 p refs Transl. into ENGLISH from Geol. Rundschau, v. 28, no. 6/7, 1937 p 499–541
(Contract NASw-1694)
(NASA-TT-F-11589) CFSTI: HC$3.00/MF$0.65 CSCL 08K

An attempt is made to establish a classification scheme for eruptive processes on the basis of physico-chemical principles. It is first pointed out that the difference in behavior between basic and acid magmas cannot be unconditionally dependent on the initial gas content of these magmas but that basic magmas may also be rich in gas. The possibilities of tectonic migration are discussed and it is shown that tectonic phenomena in no way require the assumption of any special magma activity that would indicate internal vapor pressures exceeding the normal plutonic pressure. Finally, a natural scheme of the various eruptive activities is established on the basis of relationships involving viscosity and explosive properties and, in addition, these activity categories are then differentiated into area- and central-volcanism from the geological standpoint. Author

N68-24957 Joint Publications Research Service, Washington, D. C.
RESEARCH ON 19TH VOYAGE OF THE MIKHAIL LOMONOSOV
13 May 1968 41 p refs Transl. into ENGLISH from Issled. v Severo-Zapadn. Chasti Indiyskogo Okeana (Sevastopol), 1967 p 35–58, 90–107
(JPRS-45341) CFSTI: $3.00

CONTENTS:

1. TURBULENCE INVESTIGATIONS IN THE OCEAN G. Yu. Aretinskiy, V. Z. Dykman, A. V. Zhivaykin, N. A. Panteleyev, and K. I. Chigrakov p 1–7 refs (See N68-24958 14-13)

2. SOME RESULTS OF INVESTIGATION OF TURBULENT EXCHANGE IN THE ATMOSPHERIC SURFACE LAYER OVER THE INDIAN OCEAN M. F. Naumenko p 8–13 refs (See N68-24959 14-13)

3. DISTRIBUTION OF SUSPENSIONS IN THE WATERS OF THE ARABIAN SEA G. G. Neuymin, Ye. A. Agafonov, and N. A. Sorokina p 14–23 refs (See N68-24960 14-13)

4. SELF-CONTAINED INSTRUMENTS FOR CONTINUOUS REGISTRY OF TEMPERATURE AND CURRENT VELOCITY FLUCTUATIONS AT GREAT DEPTHS IN THE OCEAN G. Yu. Aretinskiy, V. Z. Dykman, A. V. Zhivaykin, N. A. Panteleyev and K. I. Chigrakov p 24–30 ref (See N68-24961 14-13)

5. REMOTE CONTROL OF DEEP-WATER HYDROOPTICAL APPARATUS V. M. Zaikin, G. G. Neuymin, and A. N. Paramonov p 31–35 refs (See N68-24962 14-13)

6. RADIOACTIVITY IN THE ATMOSPHERIC SURFACE LAYER OF THE NORTHERN PART OF THE INDIAN OCEAN A. D. Zemlyanoy and V. P. Kotel'nikov p 36–41 refs (See N68-24963 14-13)

N68-24958 Joint Publications Research Service, Washington, D. C.
TURBULENCE INVESTIGATIONS IN THE OCEAN
G. Yu. Aretinskiy, V. Z. Dykman, A. V. Zhivaykin, N. A. Panteleyev, and K. I. Chigrakov *In its* Res. on 19th Voyage of the Mikhail Lomonosov 13 May 1968 p 1–7 refs (See N68-24957 14-13)

Turbulent structure of the velocity and temperature fields in the abyssal layers of the northwestern part of the Indian Ocean were made during the 19th voyage of the research vessel, Mikhail Lomonosov, with three types of autonomous turbulence meters. Results indicate that at the beginning of the summer monsoon, the turbulent processes correspond to a model of locally isotropic turbulence. A different picture was presented by investigations of bottom currents in the shallow waters of the Arabian Sea along the western shore of the Hindustan peninsula, for which the exchange coefficients were two orders of magnitude greater than for the abyssal layers. M.W.R.

N68-24959 Joint Publications Research Service, Washington, D. C.
SOME RESULTS OF INVESTIGATION OF TURBULENT EXCHANGE IN THE ATMOSPHERIC SURFACE LAYER OVER THE INDIAN OCEAN
M. F. Naumenko *In its* Res. on 19th Voyage of the Mikhail Lomonosov 13 May 1968 p 8–13 refs (See N68-24957 14-13)

Preliminary results are presented for measurements made at 17 drift stations in the Indian Ocean; and continuous records were obtained of air temperature using thermistor sensors mounted on the foremast of the research vehicle, as well as for the temperatures of the sea surface with a sensor attached to a free-floating foam plastic buoy. Wind direction and velocity were measured 25 m above the water surface, and the wind profile was described by a logarithmic law in the case of neutral stability conditions. Values of the stability criterion ranged from −0.006 to +0.008; the principal state in summer was found to be a state of neutral equilibrium. Wind velocity ranged from 5 to 7 m/sec, and dynamic velocities are 3.5% of the mean wind velocities. Difference between water and air temperatures did not exceed 3°C. While gradient measurements made by shipboard equipment are considered adequately reliable, allowances must be made for the effect of the ship's hull and rolling on the wind field in the near-water layer. M.W.R.

N68-24960 Joint Publications Research Service, Washington, D. C.
DISTRIBUTION OF SUSPENSIONS IN THE WATERS OF THE ARABIAN SEA
G. G. Neuymin, Ye. A. Agafonov, and N. A. Sorokina *In its* Res. on 19th Voyage of the Mikhail Lomonosov 13 May 1968 p 14–23 refs (See N68-24957 14-13)

Distribution of suspended matter in the waters of the northwestern part of the Indian Ocean were made by an optical method from the surface to depths of 1,000 to 12,000 m at 27 stations; and at a number of these stations, relative distribution was compared with the vertical temperature and salinity distributions as well as with the distribution of plankton. In some areas near the shore there is extremely high content of suspended matter associated with an abundance of plankton. In general, deeper waters contain less suspended matter and are more homogeneous; and, in many regions, there is an increased concentration of suspensions in the bottom layers. However, it does not seem possible to establish an exact correlation between the quantity of suspended matter and the types of water masses, and it is cautioned that the obtained data must be regarded as preliminary pending more detailed studies. M.W.R.

N68-24961 Joint Publications Research Service, Washington, D. C.

SELF-CONTAINED INSTRUMENTS FOR CONTINUOUS REGISTRY OF TEMPERATURE AND CURRENT VELOCITY FLUCTUATIONS AT GREAT DEPTHS IN THE OCEAN

G. Yu. Aretinskiy, V. Z. Dykman, A. V. Zhivaykin, N. A. Panteleyev, and K. I. Chigrakov *In its* Res. on 19th Voyage of the Mikhail Lomonosov 13 May 1968 p 24–30 ref (See N68-24957 14-13)

Self-contained and self-floating turbulence meters were used by a research vessel to obtain continuous temperature and current velocity data at abyssal depths of the Indian Ocean. Testing of the two instruments is described, along with their measurement capabilities. M.W.R.

N68-24962 Joint Publications Research Service, Washington, D. C.

REMOTE CONTROL OF DEEP-WATER HYDROOPTICAL APPARATUS

V. M. Zaikin, G. G. Neuymin, and A. N. Paramonov *In its* Res. on 19th Voyage of the Mikhail Lomonosov 13 May 1968 p 31–35 refs (See N68-24957 14-13)

A two-circuit relay system is described that can cut in and out of autonomous current sources as well as change the light filters in underwater optical apparatus; and communication with the shipboard recorder is via a single-strand electrical and supporting cable. Relay circuits of the automation unit are shown, for which the improved model of the digital pulse photometer transparency meter can be used in any telemetrically controlled apparatus when (1) remote control of current cutting in is required and (2) functional units of the instruments must be controlled with a single-wire communication line. M.W.R.

N68-24963 Joint Publications Research Service, Washington, D. C.

RADIOACTIVITY IN THE ATMOSPHERIC SURFACE LAYER OF THE NORTHERN PART OF THE INDIAN OCEAN

A. D. Zemlyanoy and V. P. Kotel'nikov *In its* Res. on 19th Voyage of the Mikhail Lomonosov 13 May 1968 p 36–41 refs (See N68-24957 14-13)

Preliminary results are presented for measurements of atmospheric radioactivity over the northern part of the Indian Ocean that were made in the summer of 1966. Samples of sea water were taken to determine quantities of strontium 90, cesium 137, and cerium 144; and beta activity of fallout samples were made during the voyage of a Soviet research ship. Isotopic composition of aerosols and concentration of radioisotopes in the air were determined. Air beta activity was considerably higher than on a previous voyage, attributable to a nuclear explosion on the ninth of May as well as to seasonal variations. Rains significantly increased fallout activity, but air activity varied insignificantly. Local meteorological processes occurring in the atmospheric surface layer above the water are considered to exert an extremely brief and partial effect on the global process of radioactive air contamination. Gamma spectra of aerosols are included for both May and June. M.W.R.

N68-25106# Goodyear Atomic Corp., Piketon, Ohio.

ENVIRONMENTAL RADIATION LEVELS AND CONCENTRATIONS Second Half and Annual Summaries, 1967

B. Kalmon and S. H. Hulett 8 Feb. 1968 16 p

(Contract AT(33-2)-1)

(GAT-553) CFSTI: HC $3.00/MF $0.65

The average environmental radiation and concentration levels for the Goodyear Atomic Corporation gaseous diffusion plant, for the second half of 1967 and for the calendar year 1967, are summarized. The results for the first half of 1967 have been previously reported but are also included in tabular form. For the second half of 1967, the water beta-gamma and the background exposure increased over the first half values. The air alpha, air beta-gamma, and the water alpha remained essentially unchanged. For calendar year 1967 versus calendar year 1966, all values remained unchanged except for the water beta-gamma value which increased significantly. However, the 1967 value is only 0.24% of the AEC concentration standard. Penetrating background dose rates remained unchanged from the 1966 values. In the calculations all of the exposure rates were assumed attributable to plant operations. As in the past, however, the off-site and on-site patterns are very much alike in form and intensity with no significant difference between average values. Based on the on-site and off-site intensities, it is evident that the plant operations have not added appreciably to the general background penetrating radiation. Author

N68-25120*# Geological Survey, Denver, Colo.

EVALUATION OF INFRARED IMAGERY APPLICATIONS TO STUDIES OF SURFICIAL GEOLOGY, YELLOWSTONE PARK

Kenneth L. Pierce May 1968 34 p refs

(NASA Order R-09-020-015)

(NASA-CR-94789) CFSTI: HC $3.00/MF $0.65 CSCL 08G

Infrared imagery, in the 3–5 micron band, was obtained during afternoon and post-sunset hours of August 1966. Analysis of these data reveals that known thermal features such as hot and cold springs, glaciers and snow fields and lakes are readily identified on day and night images but that areas of known "hydrothermal" alteration are not detectable by the system employed. Surficial deposits such as talus and frost rubble are generally light toned but commonly darker than outcrops warmed by solar radiation. Sharp contrasts were noted between forest and grassland areas. Attempts were made to use the imagery in mapping surficial deposits in several areas but results were variable due to the overriding effects of outcrop-forest-grassland contrasts. Recommendations for future missions are presented. Author

N68-25186*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.

VLF ELECTRIC AND MAGNETIC FIELDS OBSERVED WITH THE JAVELIN 8.45 SOUNDING ROCKET

Stanley D. Shawhan and Donald A. Gurnett Mar. 1968 52 p refs

(Contracts NSR-16-001-025; Nonr-1509(06); Grant NGR-16-001-043)

(NASA-CR-94757; Rept.-68-20) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The Javelin 8.45 rocket VLF experiment flown from Wallops Island at 07:38 UT, 21 September 1967, to an altitude of 763 km is described. A noise band between about 7.5 KHz and 30 KHz was observed with both the electric and magnetic receivers. The field geometry of this noise suggests that the noise is propagating perpendicular to the geomagnetic field and that the lower cutoff frequency may be the lower hybrid resonance frequency. Intense noise bursts below 1 KHz were observed on the electric antennas below 500 km altitude. Some evidence suggests that this electric antenna noise may be generated by the motion of the payload. The magnitude of the electric antenna impedance varied from a minimum of about 150 Kohms at 350 km altitude to about 600 Kohms at apogee. A large phase perturbation, usually inductive, was observed at altitudes below about 500 km whenever the antenna was aligned nearly parallel to the geomagnetic field. The electric field signal from the nosecone transmitter was attenuated much more rapidly than the magnetic field. Author

N68-25191# Rhode Island Univ., Kingston. Dept. of Electrical Engineering.

ELECTROMAGNETIC FIELDS IN THE OCEAN NEAR A SHORELINE

John E. Spence, Edmund J. Sullivan, and James J. Beville *In* AGARD Sub-Surface Commun. 1966 p 97–113 refs (See N68-25187 14-07)
(Contract Nonr-396(10))

The electromagnetic fields in the ocean resulting from ground wave excitation over land by natural electromagnetic noise such as Micro-pulsation or ELF Atmospherics are investigated analytically. A simplified two-dimensional model is used. The purpose of the study is to determine the relative importance of electromagnetic energy propagation via air into the ocean versus propagation through the soil and ocean bottom into the sea. Vertical profiles of the horizontal electric field are plotted for several values of frequency, ocean depth, and the distance from the shoreline. The relative importance of the soil path is seen to be greater for shorter distances from the shore and for deeper oceans. Author

N68-25192# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences and Aeronomy.
ELECTROMAGNETIC PROPAGATION IN AN IDEALIZED EARTH CRUST WAVEGUIDE
James R. Wait *In* AGARD Sub-Surface Commun. 1966 p 115–132 refs (See N68-25187 14-07)
(ARPA Order 183-62)

An electromagnetic waveguide in the earth's crust is idealized as a homogeneous lossy dielectric slab which is bounded by two homogeneous semi-infinite conducting media. The source is a vertical-electric dipole which is either above or below the upper surface of the horizontal slab. The exact integral formula for the field is evaluated by function-theoretic means. It is shown that the dominant contributions are the propagating waveguide modes in the slab, although the lateral waves should not be ignored. The excitation of the waveguide modes and the relevant height-gain and depth-gain functions are also discussed. The attenuation characteristics of the modes are considered in some detail. It is shown that the principal loss mechanisms are the ohmic dissipation within the waveguide and the energy transmitted through the upper and lower walls into the bounding media. A numerical example is chosen where all three loss mechanisms are of the same order of magnitude. Author

N68-25193# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences and Aeronomy.
INFLUENCE OF A SUB-SURFACE INSULATING LAYER ON ELECTROMAGNETIC GROUND WAVE PROPAGATION
James R. Wait *In* AGARD Sub-Surface Commun. 1966 p 133–146 refs (See N68-25187 14-07)

The exact formal solution for an electric dipole over a planar stratified medium is evaluated in the asymptotic limit. Special attention is given to the situation where one of the strata is effectively an insulator. In this case, a waveguide type of propagation is possible which, in some cases, may be significant. Author

N68-25196# Army Electronics Labs., Fort Monmouth, N. J. Communications/ADP Lab.
SOME MEASURED ELECTRICAL CHARACTERISTICS OF THE EARTH'S CRUST
M. Acker and L. J. Mueller *In* AGARD Sub-Surface Commun. 1966 p 211–238 refs (See N68-25187 14-07)

Resistivity well log measurements were made in two drill holes extending 3 km into basement igneous rock, and electrical measurements were made on core samples taken from these holes at various depths. The measurements defined the conductivity, permittivity, dissipation factor, and composition of the crustal rock to a depth of 3 km. The resistivity well log data is discussed and the interpreted conductivity from this data is shown to vary from 10^{-4} mhos/meter at a depth of 0.5 km to slightly less than 10^{-5} mhos/meter at 3 km. Measurements indicate that low conducitivity is usually associated with dry rock samples and a higher conductivity with untreated or wet samples. The wet sample conductivity may be two or three orders of magnitude greater than for the dry samples. A projection of available conductivity data to depths below the drill hole level of 3 km indicates that the conductivity of the basement medium may be as low as 10^{-6} mhos/meter or lower at the greater depths. A theoretically calculated curve of plane wave attenuation versus conductivity is included. Author

N68-25197# DECO Electronics, Inc., Boulder, Colo.
A 10 KHz EFFECTIVE CONDUCTIVITY MAP OF NORTH AMERICA
Eugene L. Maxwell and Robert R. Morgan *In* AGARD Sub-Surface Commun. 1966 p 239–264 refs (See N68-25187 14-07)
(Contracts Nonr-4107(00); Nonr-3387(00))

The correlation between geology, topography, weather and the electrical conductivity of the earth have been used to prepare a conductivity map of North America effective at 10 kHz. This map was produced specifically to aid in computing phase velocities for the Omega Navigation System. To accomplish this task the conduction processes that are predominant within earthen materials at frequencies from a few hundred kHz down to d.c. and the natural parameters affecting these conduction processes were studied. In addition, conductivity measurements made in Northern Canada are reported along with a discussion of permafrost characteristics. This is some of the first conductivity data available from that region. Data for correlating geology, topography and weather with the electrical conductivity of the earth were generally found to be inadequate in quantity and quality. The kind of data which should be collected to facilitate future efforts is discussed and it is suggested that international scientific organizations could assist in encouraging data collection useful to various scientific domains. Author

N68-25198# Geoscience, Inc., Cambridge, Mass.
THE ELECTRICAL RESISTIVITY OF WATER SATURATED CRYSTALLINE ROCKS
Arnold S. Orange, W. F. Brace (MIT, Cambridge, Mass.), and T. R. Madden *In* AGARD Sub-Surface Commun. 1966 p 265–285 refs (See N68-25187 14-07)
(Contract AF 19(628)-3298)

Electrical resistivity of 8 igneous rocks and 2 crystalline limestones was measured at pressures to 10 kb. The dependence of resistivity on temperature, porosity, and pore fluid salinity suggested the conduction was primarily electrolytic throughout the entire pressure range, even though the porosity of some rocks was less than 0.1%. The changes of resistivity with pressure paralleled changes of compressibility with pressure, being rapid over the first 2 kb and tapering off more gradually at higher pressures. The data suggests that the electrical conduction of these rocks consists of (1) conduction along cracks below a few kb pressure and (2) volume and surface conduction along a network of pores which persists throughout the entire pressure range. The surface conduction of the rocks saturated with tap water was 10 and 20 times greater than the volume conduction of the pores. Extrapolation of the laboratory values to the development of a crustal resistivity profile is not feasible due primarily to the uncertainties surrounding the crustal temperature profile. Author

N68-25199# Geoscience, Inc., Cambridge, Mass.
RESULTS OF IN SITU ROCK RESISTIVITY MEASUREMENTS
K. Vozoff, T. Cantwell, H. Lahman, and Arnold S. Orange *In* AGARD Sub-Surface Commun. 1966 p 287–307 refs (See N68-25187 14-07)
(Contracts AF 19(628)-2351; Nonr-4287(00))

Four-electrode d.c. earth resistivity measurements were carried out in precambrian rocks at or near the surface. It was found that resistivity in most areas was very inhomogeneous, and seldom

exceeded 10^4 ohm meters. Bulk resistivity on one traverse line in central Wisconsin and on several lines in the Adirondacks was homogeneous, but did not exceed 5×10^3 Ωm in the former case and 2.5×10^4 Ωm in the latter. Interpreted resistivities correlated with rock type and with degree of fracturing, being greatest in relatively unfractured basic intrusives, and least in highly-fractured sedimentary and metamorphic rocks, and in extrusives. The observation that *in situ* resistivity is less, by one–two orders of magnitude, than that measured on small samples indicates that fracturing and inhomogeneity exist in all rocks to depths of at least 5–10 km. This is in agreement with geological experience on all scales from the microphotographic to the aerial-photographic.
Author

N68-25206# London Univ. (England). Wheatstone Physics Lab.
OBSERVATIONS ON THE PROPAGATION CONSTANT OF THE EARTH-IONOSPHERE WAVEGUIDE IN THE FREQUENCY BAND 8 C/S TO 16 KC/S
F. W. Chapman, D. Llanwyn Jones, J. D. W. Todd, and R. A. Challinor *In* AGARD Sub-Surface Commun. 1966 p 425–451 refs (See N68-25187 14-07)

Recent observations concerning the determination of the propagation constant (attenuation and phase velocity) of electromagnetic waves over the earth's surface are described. The experimental techniques employed include the use of single station and two station magnetic recording of atmospherics (sferics) propagated over great distances and the observation of the frequencies and Q-factors of Schumann resonances. The experimental results are interpreted in terms of the waveguide mode theory of propagation by assuming various electron and heavy ion density profiles for the ionosphere. The present work agrees well with the observations of other workers made over a limited frequency range and enables the propagation constant to be determined from 8 c/s to 16 kc/s.
Author

N68-25207# Navy Underwater Sound Lab., New London, Conn.
UNDERSEA ELF MEASUREMENTS OF THE HORIZONTAL E-FIELD TO DEPTHS OF 300 METERS
E. F. Soderberg *In* AGARD Sub-Surface Commun. 1966 p 453–470 refs (See N68-25187 14-07)

The paper presents and discusses measurements made by a two-man submersible 'Diving Saucer' off the coast of Baja California for two particular time periods in March 1965. The object was to provide an introductory look at the levels of extremely-low-frequency noise in the ocean. Within certain limitations, the results indicate the possibility of bottom-conducted atmospheric energy near a shoreline.
Author

N68-25211# Danish Defence Research Board, Copenhagen.
ELECTROMAGNETIC BACKGROUND NOISE IN THE ELF RANGE
L. Brock-Nannestad *In* AGARD Sub-Surface Commun. 1966 p 543–556 refs (See N68-25187 14-07)

The paper gives a brief review of the properties of earth-ionosphere cavity and its excitation by lightning. The propagation into a stratified earth is treated in some detail and, as a typical application, a new method for geophysical investigations in shallow waters is described. Various measuring techniques are discussed briefly.
Author

N68-25212# DECO Electronics, Inc., Boulder, Colo.
ATMOSPHERIC NOISE FROM 20 HZ TO 30 KHZ
Eugene L. Maxwell *In* AGARD Sub-Surface Commun. 1966 p 557–593 refs (See N68-25187 14-07)
(Contract Nonr-3387(00))

This paper discusses measurements of atmospheric noise which have been made at various times during the past two years in Malta, GC; Point Barrow, Alaska; Boulder, Colorado; Tokyo, Japan; Hawaii, Miami, Florida and at various locations throughout Central and South America. Most of the measurements were average measurements of the vertical electric field intensity and amplitude probability distributions of the vertical electric fields. The atmospheric noise spectra obtained at these widely spaced locations over this large frequency range provide a good basis for rough estimates of noise field intensities at any global location. The results correlate well with lightning spectra and propagation attenuation coefficients. The amplitude probability distributions provide interesting and useful information regarding the characteristics of the noise and are used to convert the average measurements to root mean square values. These are some of the first amplitude probability distributions obtained throughout this frequency range. Subsurface noise spectra have been computed for several earth models as an aid to subsurface communicators.
Author

N68-25213# Hughes Aircraft Co., Los Angeles, Calif.
REPORT OF ELECTROMAGNETIC DETECTION OF VERY LOW FREQUENCIES MADE IN A BATHYSCAPH IN DEEP WATER [COMPTE-RENDU D'ENREGISTREMENTS ELECTROMAGNETIQUES A TRES BASSE FREQUENCES FAITSEN BATHYSCAPHE EN EAUX PROFONDES]
E. Selzer (Inst. de Phys. du Globe), L. Launay (Inst. de Phys. du Globe), and S. W. Lichtman *In* AGARD Sub-Surface Commun. 1966 p 595–606 refs In FRENCH (See N68-25187 14-07)

Electromagnetic monitoring at very low frequencies was continued up to 200 hertz using the French bathyscaph, the Archimede at depths between 2,000 and 8,000 m. Principal tests were made near the Puerto Rican trench and in the open sea off Cap Matapan, Greece, and Toulon, France. Detailed spectral analyses were made; and a reproducibility in the data, often quasi-stationary, is indicated when the influences of perturbations are eliminated.
Transl. by M.W.R.

N68-25251*# Geological Survey, Menlo Park, Calif.
GEOTHERMAL STUDIES: YELLOWSTONE NATIONAL PARK (TEST SITE II), WYOMING
D. E. White, R. O. Fournier, L. J. P. Muffler and A. H. Truesdell May 1968 15 p ref
(NASA Order R-09-020-015)
(NASA-CR-94781; NASA-109) CFSTI: HC $3.00/MF $0.65
CSCL 08G

Investigations of thermal areas in Yellowstone National Park include the correlation of subsurface temperatures determined by diamond drilling, surface temperature measurements, and remote sensor data. This report, in two parts, describes (1) the preliminary results of diamond drilling, summarizing lithology, subsurface temperatures and pressures in the drill holes, and (2) a method of using heavy snow fall in calorimetric determinations. The snow fall method appears applicable to repetitive photographic and infrared observation from space. Passive microwave imaging radiometers might assist such studies but have not yet been tested. The drilling information is to be correlated with analyses of surface monitoring and aircraft remote sensor data.
Author

N68-25371# Japan Atomic Energy Research Inst., Tokyo. Health Physics and Safety Div.
ANALYSIS OF CURRENT VELOCITY AND DIRECTION OFF TOKAI-MURA
Tanigawa Yoshiro 1968 12 p refs In JAPANESE; ENGLISH summary
(JAERI-4044) CFSTI: HC $3.00/MF $0.65

The characteristics of the sea current off Tokai-mura were investigated with the data obtained from 1963 to 1966. The current was measured by two methods. One is by the track of drift markers with a resistance plate at a given depth, the position of which is determined at regular intervals by a pair of theodolites

at the beach of Tokai-mura. The other method is by propeller driven self-recording current meters, suspended at the measuring depth at the observation stations, 700 m and 1400 m off shore, the measuring period being about two or three days. As a result, it was found the current velocity was about 10 cm/sec. However, weak currents, insufficient for the sensitivity of current meters employed, also exist to a larger extent than anticipated. On the frequency distribution of current directions, during the year, two peaks were observed, which were "north" and "south". Author

N68-25376 St. Louis Univ., Mo.
MODEL STUDY OF SEISMIC EFFECTS OF EXPLOSIONS IN PRESTRESSED MEDIA
Won Ho Kim (Ph.D. Thesis) 1966 108 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-2957

Seismic effects of explosions in two-dimensional prestressed models are investigated. This study differs from the conventional two-dimensional modeling in two aspects: (1) the medium is prestressed in uniaxial tension and (2) small amounts of chemical explosives are utilized to generate the seismic energy. Plexiglass and aluminum sheets subjected to static loading exhibited a definite anisotropic effect, but this effect was not large enough to affect wave propagation in the range of the tensile loads applied. Observed radiation patterns resulting from explosions in prestressed media indicate asymmetrical radiation fields which are a direct consequence of strain energy release for the case of aluminum and by the combined effects of directional cracking and energy release for the case of Plexiglas. An empirical relationship for S-wave amplitudes is obtained in terms of the energy release and the intensity of stress field using experimental results. Dissert. Abstr.

N68-25383 California Univ., Los Angeles.
THE EFFECT OF VIBRATIONAL RELAXATION ON ATMOSPHERIC HEATING IN THE 4.3 MICRON C_2 BAND
Robert Alan McClatchey (Ph.D. Thesis) 1966 121 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-554

In the present investigation calculations of atmospheric heating rate will be made for one vibration–rotation band of carbon dioxide (the 4.3 micron band) without recourse to the usual assumption of local thermodynamic equilibrium. In addition the effect of combined Doppler and pressure broadening of the special lines is taken into account. The calculations are made for a pressure range between 10 mb and 10^{-4} mb. An equation for the monochromatic heating rate is established and solved repeatedly for small frequency intervals across the entire 4.3 micron CO_2 band. The calculations demonstrate that at very low pressure levels the heating rate is 3 to 4 orders of magnitude lower than would have been computed under the assumption of local thermodynamic equilibrium. The heating rate computed for the portion of the atmosphere between 10 mb and 0.1 mb is shown to be considerably lower than the usually assumed heating rate based on the square root absorption law. This is primarily due to the effect of Doppler line broadening. Dissert. Abstr.

N68-25432*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE WINTER HELIUM BULGE
Gerald M. Keating and Edwin J. Prior [1967] 11 p refs Presented at the 1967 IQSY/COSPAR Assembly, London, 17–29 Jul. 1967
(NASA-TM-X-60248) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Analysis of Air Density Explorer data (Explorers 9, 19, and 24) covering the altitude range 390 to 880 kilometers during the period 1961 through 1966 reveals that the diurnal atmospheric density bulge shifts with increasing altitude from the summer hemisphere (i.e., hemisphere on sun side of equator) to the winter hemisphere. The winter diurnal bulge occurs at approximately 1400 local solar time and migrates latitudinally in the opposite sense of the sun. The observed shifts of the diurnal bulge are explained as follows: (1) The exospheric temperature peaks near the latitude of the subsolar point. (2) The helium concentration at 120 kilometers is more than 2.5 times as high near the winter pole as it is near the summer pole. Thus, at altitudes where atomic oxygen is the primary constituent, peak density occurs in the summer; at the higher altitudes where helium predominates, peak density occurs in the winter. Helium concentrations at 120 kilometers are inferred from the high-altitude Air Density Explorer data. The effects of altitude, solar activity, geomagnetic activity, local solar time, and the semiannual variation are taken into account. The resulting mean helium concentration is significantly greater than given by CIRA, 1965, and slightly greater than given by the U.S. Standard Atmosphere Supplements, 1966. The latitudinal–seasonal variation in helium boundary conditions can be explained as the result of a variation in the effective altitude at which diffusive separation of helium begins and/or as the result of a seasonal variation in atmospheric densities at 100 kilometers inferred principally from falling sphere data. Both Echo II drag data and Explorer XVII mass spectrometer data are found to confirm the existence of a winter helium bulge. Author

N68-25474# Groupe de Recherches Ionospheriques, Paris (France).
GIVEN IONOSPHERICS OF GARCHY, MARCH–APRIL 1966 [DONNEES IONOSPHERIQUES DE GARCHY, MARS–AVRIL 1966]
1966 51 p In FRENCH
CFSTI: HC $3.00/MF $0.65

Tabulated data are presented on ionospheric characteristics, their coding, and their calculated mean values. Summary information is included on the geographic and geomagnetic coordinates, magnetic inclination, and recording equipment of the reporting station. Transl. by M.G.J.

N68-25475# Groupe de Recherches Ionospheriques, Paris (France).
GIVEN IONOSPHERICS OF GARCHY, MAY–JUNE 1966 [DONNEES IONOSPHERIQUES DE GARCHY, MAI–JUIN 1966]
1966 49 p In FRENCH For abstract, see N68-25474
CFSTI: $3.00

N68-25476# Groupe de Recherches Ionospheriques, Paris (France).
GIVEN IONOSPHERICS OF GARCHY, JULY–SEPTEMBER 1966 [DONNEES IONOSPHERIQUES DE GARCHY, JUILLET–AOUT–SEPTEMBRE, 1966]
1966 74 p ref For abstract, see N68-25474
CFSTI: HC $3.00/MF $0.65

N68-25579*# Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.
STUDY OF MINERAL STABILITY IN THE LUNAR ENVIRONMENT Final Report
Washington, D. C. NASA Jun. 1968 285 p refs
(Contract NAS9-3734)
(NASA-CR-1034; BSR-2022) CFSTI: HC $3.00/MF $0.65 CSCL 08G

Stability of selected earth minerals in simulated lunar environments were investigated through laboratory experiments.

Analyses of the reactions of the minerals to exposure of vacuum and thermal environments and their chemical and structural stability when exposed to spacecraft and earth environments were studied. Short term experiments included validation of mineral identification of 14 minerals, and provision of insight into reactions expected and standards for comparison with results obtained from the long term experiments. Long term testing involved a single temperature cycle at simulated lunar vacuum environment, X-ray photographs of each sample at various stages of the temperature cycle, a four day simulation of spacecraft environment, and a two day exposure to earth environment. It was noted that the change in environment, even over a short time interval, was sufficient to cause major changes in some phases, and that predicted equilibrium stability relations should be the overriding factor in determining the phase occurring on the lunar surface. A.L.

N68-25585# Defence Research Board, Ottawa (Ontario).
STRUCTURES AND GRAVITY ANOMALIES OF CRYOGENIC ORIGIN IN THE BAIKAL REGION. MAXIMUM DEPTHS OF PERMAFROST
A. P. Bulmasov, A. I. Yefimov, and I. Ye. Dukhin Apr. 1968 22 p refs Transl. into ENGLISH from Geol. i Geofiz. (USSR), no. 2, 1963 p 75–85 and no. 7, 1966 p 92–97
(DRB-T-482-R) CFSTI: HC $3.00/MF $0.65

The first paper deals with certain structures, very widely distributed in the Baikal region, that are related to permafrost beds, and describes their physical properties. Examples are given to show the ineffectiveness of the geomorphological method of investigating deep structures, which is due to the absence in permafrost zones of any inheritance of structural form in depth. A distinct relationship is noted between gravity anomalies and features of the geological structure in permafrost zones. Negative gravity anomalies are shown to be characteristic for positive uplifted structures related to permafrost. The second paper presents arguments disputing the findings on permafrost thicknesses given in the first paper. Author

N68-25589# Madrid Univ. (Spain). Facultad de Ciencias.
GEODESY COORDINATE VARIATIONS OF THE VERTEXES OF A GRID, BY CHANGING THE ELLIPSOID OF REFERENCE [VARIACIONES DE LAS COORDENADAS GEODESICAS DE LOS VERTICES DE UNA RED, POR CAMBIO DE ELIPSOIDE DE REFERENCIA]
Jose Maria Gonzalez Aboin 1966 25 p In SPANISH Submitted for publication
(Publ.-59) CFSTI: HC $3.00/MF $0.65

A study is made of the variations of the geodesic latitude and longitude coordinates caused by a change in the ellipsoid of reference, both in its dimensions and form and in the position of the axes of said areas. The transformation for passing from one ellipsoid to another is resolved in the three dimensional Euclidean space by means of a parallel translation and a circumference around the Z axis and later passing to the new ellipsoid by means of a normal projection at its surface. Formulas are obtained by the least squares method using the coordinates in both systems from a series of vertices. Of practical interest is the passing of the coordinates of the Madrid system to those of the European system for the vertices of the distinct geodesic grids which were not entered in the RE 1950 compensation. The formulas are applied to the vertices of the Spanish fundamental grid. In order to effect the passing of the coordinates of the Madrid system to the European system with better precision, complementary terms of correction of the empirical type with parameters are introduced. Transl. by R.N.A.

N68-25644*# Volt Technical Corp., Washington, D. C.
ON THE DISRUPTION OF THE RECIPROCITY PRINCIPLE DURING THE DAYTIME PROPAGATION OF SUPER LONG RADIOWAVES AROUND THE EARTH [O NARUSHENII PRINTSIPA VZAIMNOSTI PRI RASPROSTRANENII SVERKHDLINNYKH RADIOVOLN VOKRUG ZEMLI V DNEVNOYE VREMYA]
P. E. Krasnushkin and R. B. Baybulatov Greenbelt, Md. NASA Goddard Space Flight Center 24 May 1968 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Geofiz. (USSR), v. 171, no. 2, 1966 p 340–343
(Contract NAS5-12487)
(NASA-CR-94794; ST-RWP-AM-MAT-10717) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The disruption of the reciprocity principle during the daytime propagation of superlong radiowaves around the earth is discussed on the basis of the so-called valve effect taking place in daytime near the equatorial region. Author

N68-25654*# Volt Technical Corp., Washington, D. C.
METHOD FOR THE SOLUTION OF THE GENERAL BOUNDARY VALUE PROBLEM OF PROPAGATION OF LONG AND ULTRALONG RADIOWAVES AROUND THE EARTH [METOD RESHENIYA OBSHCHEY KRAYEVOY ZADACHI RASPROSTRANENIYA DLINNYKH I SEVRKHDLINNYKH RADIOVOLN VOKRUG ZEMLI
P. E. Krasnushkin Greenbelt, Md. NASA. Goddard Space Flight Center 21 May 1968 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Matematucheskaya Fiz. (USSR), v. 171, no. 1, 1968 p 61–64
(Contract NAS5-12487)
(NASA-CR-94798; ST-RWP-MAT-10716) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The method consists in the consideration of these waves in a boundless medium subdivided into three regions, the Earth, atmosphere and ionosphere. The solution of the boundary value problem is sought by using the method of connected lines. In this work the author refers to a number of his previous works on the subject of long and ultralong radiowaves, alongside with some earlier foreign works. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N68-24374# Suffield Experimental Station, Ralston (Alberta).
EVALUATION OF A DOUBLE-PASS SCHLIEREN SYSTEM
J. J. Gottlieb 21 Feb. 1968 18 p ref
(Suffield-MEMO-54/67) CFSTI: HC $3.00/MF $0.65

A standard double pass schlieren system, using the off-set mirror technique, was modified by the use of a beam splitter, to avoid the misalignment problems that occur with the normal off-set mirror technique. The 24 inch double pass schlieren system was designed for single spark photographs and high speed multiple-frame photography. Author

N68-24392*# Physics Technology Labs., Inc., La Mesa, Calif.
R F ION MASS SPECTROMETER CALIBRATION ION SOURCE SYSTEM Final Report, Oct. 1964–Mar. 1968
Mar. 1968 130 p (Contract NAS5-9513)
(NASA-CR-94687) CSCL 20F

The plasma-ion source system described in this report and used for ground calibration of the Bennett RF ion mass spectrometer produces monoenergetic beams of space charge neutralized ions of all gaseous species (atomic and molecular) from mass 1 to mass 40. Beam energies produced have been from 2 to 100 eV of ± one volt energy spread with maximum densities above 10^{-8} amps/cm^2 (10^4 to 10^5 ions/cc). An RF head may be used to produce a source plasma rich in the atomic species of a particular ion for the production of beams of high atomic composition. Nitrogen beams of over 30% N^+ and hydrogen beams of over 60% H^+ have been generated. A hot filament head can alternately be used for prolonged, stable, and reliable operation. This source is preferable at very low energy beam production when isolation of rf fields from the working portion of the vacuum chamber is mandatory. The calibration system consists of a vacuum chamber with two sections for differential pumping, two ion source subsystems, an integrated electronic subsystem, and a plasma-ion beam diagnostic subsystem. Capabilities, subsystem integration, and results of filament source and RF source calibrations are described. K.W.

N68-24471# Danish Meteorological Inst., Charlottenlund.
AUTOMATIC STEPWISE SUPPRESSION OF THE ZERO OF A PEN AND INK RECORDER
F. Primdahl Oct. 1967 23 p ref *Its* Geophys. Paper R-1

Described is an automatic stepwise zero suppressor instrument which was designed to extend the useful range of a pen and ink recorder used with a fluxgate magnetometer. Described are system components which include amplifier, comparator, pulse generator and transistor gate, flip-flop chain, and step network. Also included are data on the printed circuit lay-out; the power supply accuracy of the recording system; the time pulse generator; and the scale value of the magnetometer and recording system. S.C.W.

N68-24487# European Atomic Energy Community, Ispra (Italy).
THEORY FOR A TRIAXIAL AND TIME-OF-FLIGHT POLARIZATION SPECTROMETER FOR THERMAL NEUTRONS [THEORIE EINES DREIACHSEN- UND EINES FLUGZEITPOLARISATIONSSPEKTROMETERS FUER THERMISCHE NEUTRONEN]
R. Misenta Brussels Apr. 1968 59 p refs In GERMAN; ENGLISH summary
(EUR-3910.D) CFSTI: HC$3.00/MF$0.65

It is proposed to measure after scattering the energy distribution of an initially monoenergetic and polarized beam separately for the two spin states. The theory of polarization spectrometers which allows these measurements is developed and applied to two proposed experimental arrangements; a triple axis- and a time-of-flight polarization spectrometer. Also considered are the influence of an incomplete polarization of the impinging beam, the flipping probability of the spin flip device and the quality of the analyzer on the resolution by which the intensities of the two spin states can be separated. The separate measurement of the two intensities allows some new applications, e.g. in investigation of coherent and incoherent effects in the elastic and inelastic neutron scattering it is possible to separate completely the coherent and incoherent intensities. An estimate of the measuring times shows that the neutron flux of high flux reactors is sufficient for measurements with polarization spectrometers. Author

N68-24593# Eidgenoessiches Institut fuer Reaktorforschung, Wurenlingen (Switzerland).
A GENERATOR FOR PRODUCING A PRECISE DELAY OF UP TO 9 MS IN A TIMING SIGNAL
K. Behringer and E. Dubochet Jan. 1968 18 p refs
(EIR-130)

A unit has been developed which precisely delays a timing signal in steps of 60 μs up to 8.6 ms. The temperature coefficient of the delay is of the order 10^{-5}°C. Specifications are presented. Author (NSA)

N68-24595 Houston Univ., Tex.
ELECTRON AFFINITY SPECTROSCOPY BY HIGH FREQUENCY EXCITATION OF THE PULSE-SAMPLED ELECTRON CAPTURE DETECTOR
David Clarke Fenimore (Ph.D. Thesis) 1966 111 p Available from Univ. Microfilms: HC$5.60/MF$3.00 Order No. 67-2029

The pulse-sampled electron capture detector has been shown to combine extreme sensitivity with reliability for the quantitative determination of trace components separated by gas chromatography. By varying the kinetic energy of the electron population in the detector through the application of a high frequency alternating potential, this device can also be made to perform the functions of a qualitative instrument. Electron affinity spectra characteristic of a number of compounds known to undergo either or both dissociative and nondissociative electron attachment are presented and are in agreement with the observations of other investigators using instruments which are of far greater complexity or which are basically incompatible with gas chromatographic technique. In addition high-frequency excitation provides a means of increasing the sensitivity of detection of certain classes of compounds while retaining the advantages of the pulse-sampling technique. Dissert. Abstr.

N68-24611# Joint Publications Research Service, Washington, D. C.
NUCLEAR INSTRUMENT BUILDING
V. V. Matveyev, M. N. Pchelnikov, and B. I. Khazanov *In its* Soviet Atomic Sci. and Eng. 13 May 1968 p 363-385 ref (See N68-24602 14-22)

The complex requirements for the measuring apparatus used in nuclear engineering are delineated, and certain trends in scientific, technological, and analytic instrument building, and radiation safety instrument building are discussed. For measuring ionizing radiation, such devices as amplifiers, discriminators, pulse counters, pulse counting rate meters, and coincidence registration devices are being produced. Details are given on the multichannel analyzer which is cited as the principal instrument used in experimental physics. Radiometric devices, for test and control of atomic reactors and regulation of technological processes or radiochemical production, are discussed. The use of instruments and installations for activation analyses is surveyed, along with the production of individual dosimeters for testing the ionizing radiation received by each worker. The application of modular design principles and the introduction of semiconductor detectors are considered important innovations. M.G.J.

N68-24646# Tokyo Univ. (Japan). Inst. for Nuclear Study.
NUMERICAL TABLES OF THE SOLID ANGLE AND R(X) OF A MAGNETIC ANALYZER SYSTEM FOR THE INS FM CYCLOTRON
J. Kokame and K. Yagi 21 Dec. 1967 25 p refs
(INS-J-106)

Tabulations for calibrating the solid angle of the magnetic spectrometer used at the INS FM cyclotron are presented. Also, data are presented comparing the radii of the beam trajectories in the main-beam magnet and the secondary-particle magnet. This is used to calibrate the magnetic analyzer system for absolute measurement of the energies of the product particles. NSA

N68-24655# Joint Publications Research Service, Washington, D. C.

LARGE TRANSIT INSTRUMENT FOR OBSERVATIONS OF SOUTHERN HEMISPHERE STARS

A. A. Nemiro and Yu. S. Streletskiy *In its* Astrometrical Studies on Reference Stars, Catalog Errors and Stellar Instrumentation 22 May 1968 p 13–19 refs (See N68-24652 14-30)

The construction of a large transit instrument and its capabilities are described in relation to a Soviet expedition to Chile to observe the stars of the Southern Hemisphere. The instrument is shown in operating condition, and the mechanism for adjusting the tube and the level of the transit is illustrated. The transit is combined with meridian collimators and the target lenses, and a mercury-type instrument in a sealed container is placed under the floor where the transit is located. A special pavilion was constructed for the telescope. M.W.R.

N68-24682# Electrotechnical Lab., Tokyo (Japan).

ALTERNATING CURRENT STANDARD: ELECTRODYNAMOMETER TYPE AC-DC TRANSFER INSTRUMENT

Mamoru Iwamura Jun. 1967 117 p refs In JAPANESE; ENGLISH Summary *Its* Res. of the Electrotech. Lab. No. 673 CFSTI: HC$3.00/MF$0.65

The basic electrical units are determined by absolute measurement, while for practical measurements the comparison method is usually employed. In this case there must be a standard with which the unknown quantity is compared. DC quantities–voltage, current, and power—are measured precisely by means of a potentiometer and its accessories in conjunction with the Weston-Cell and standard resisters. As sufficient accuracy, say 0.01%, can be obtained easily in DC measurement, the DC standard is established satisfactorily. On the other hand in AC measurement there is no such voltage standard as the Weston-Cell. Then effective value is transferred from DC value with AC–DC Transferinstruments. AC standardization depends on the above-stated transfer system. In Author

N68-24710# United Nuclear Corp., White Plains, N. Y. Development Div.

PLUGGING METER AND CONTINUOUS OXYGEN METER

B. Minushkin 14 Apr. 1964 15 p refs

(Contract AT(30-1)-2877)

(MTL-3761; TID-24284) CFSTI: HC$3.00/MF$0.65

Two types of on-line impurity meters for liquid sodium cooling systems are discussed. A recent development in the design and use of plugging meters is described. Also, the design of an electrochemical oxygen meter is presented. NSA

N68-24711# Sandia Corp., Albuquerque, N. Mex.

TECHNOLOGY OF RAPID OPTICAL SHUTTERS [ZUR TECHNOLOGIE SCHNELL WIRKENDER OPTISCHER VERSCHLUESSE]

D. Ebeling, F. Fruengel, and J. F. Suarez [1967] 25 p refs Transl. into ENGLISH from Optik (Stuttgart), v. 25, 1967 p 359–376

(SC-T-68-1507) CFSTI: HC$3.00/MF$0.65

Generally the application of mechanical shutters for the submillisecond region is limited to apertures of less than 20 mm dia. For apertures of 20 mm up to 100 mm dia other techniques are to be used. There are described two techniques which principally utilize the explosive deformation of matter to obscure large apertures. Experimental development was undertaken with regard to very high closure speed of large apertures, little energy consumption and simple shutter construction. The first technique is based on the explosive expansion of a metal-vapour-cloud generated by an electrical discharge through a wire, the second takes advantage of the magnetic pressure, which is applied to an electrical conductor by a magnetic field. The resulting radial closure speed lies within the 700 to 5000 msec $^{-1}$ range. The according energy is about 200 Wsec for apertures ≤50 mm dia. Author (NSA)

N68-24713# Marquardt Corp., Van Nuys, Calif. ASTRO Div.

FLUIDIC (PURE FLUID) TEMPERATURE SENSOR, PHASE 1 Final Technical Report

Carl R. Halbach, Ben A. Otsap, and Richard A. Thomas Jan. 1967 89 p refs

(Contract AT(04-3)-639)

(SAN-639-7; Rept.-25212) CFSTI: HC$3.00/MF$0.65

A fluidic temperature sensor concept has been demonstrated with heated air using a frequency beating technique and detection network to generate a dc pressure signal proportional to the difference in frequencies. The frequency difference in turn is proportional to the square root of the gas temperature. This temperature sensor is being developed for use in potassium vapor and hot gases for temperatures to 2300°R. A pressure insensitive oscillator with a feedback loop and based on acoustic resonance is used as the temperature sensitive element. Signal strength as well as frequency adjustment has been enhanced with the feedback loop which is coupled to the resonance chamber. The frequency detection network which senses the beat frequency and generates the dc output pressure signal is composed of a low pass filter, a limiter, a pulse generator and square wave generator followed by a signal integration stage. Data for heated air test conditions simulating the frequency range required for potassium vapor applications are presented and discussed. The error in sensed temperature of the fluidic temperature sensor with potassium vapor is projected to be ±1.5%. This includes an analytical error to account for the effects of potassium vapor. Author (NSA)

N68-24714# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physik-Inst.

THE REACTOR NEUTRON CAPTURE CROSS SECTION OF SC^{46} AND A DETERMINATION OF THE BETA BRANCHING RATIO OF THE SC^{47} DECAY

Zong-Tschun Bak and P. Riehs 1967 10 p refs

(SGAE-PH-61/1967)

The secondary neutron capture cross section for the thermal neutron flux monitor Sc is determined as 7.7±0.6 b by activity measurements. By means of a 4π β–γ coincidence measurements, the relative intensity of the 160-keV gamma ray of ^{47}Sc was found to be 0.68±0.027 per decay. Author (NSA)

N68-24725# Minnesota Univ., Minneapolis. Cosmic Ray Group.

AN ALPHA PARTICLE PRESSURE GAUGE FOR HIGH ALTITUDE CONSTANT LEVEL BALLOON FLIGHTS

R. L. Howard, S. W. Nelson, and J. R. Winckler Feb. 1968 20 p Submitted for publication

(Grants NSF GP-1658; NSF GA-487)

(CR-114)

The alpha particle pressure gauge gives continuous readings from sea level to pressures less than 1 mb with an accuracy in the 1–10 mb range of a few tenths of a millibar. The instrument utilizes a sensitive electrometer measuring the ionization current due to a very weak polonium alpha particle source of less tha 1 μc in the form of non-reactive ceramic microspheres. The pressure is read out by the time interval between resets of the drifting electrometer in a form convenient for transmitting by radio telemetry. Temperature compensation in the electronic circuitry corrects for the gas law so that the instrument measures pressure independent of temperature to suitable accuracy between −25 and +25°C. The instrument has been tested on more than 50 balloon flights and gives reproducible and accurate results. The paper describes the complete physical and electronic operating principles and shows detailed drawings and photographs of the improved version sufficient

to enable the experimenter to construct a copy. The instrument uses all solid state components and the size, weight and power requirements are very small. Author

N68-24735# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
THE BATTELLE NORTHWEST ROTATING CRYSTAL AND PHASED CHOPPER SLOW NEUTRON SPECTROMETER
O. K. Harling 1 Mar. 1968 17 p refs Presented at Symp. on Inelastic Neutron Scattering, Copenhagen
(Contract AT(45-1)-1830)
(BNWL-SA-1536; CONF-680501-1) CFSTI: HC $3.00/MF $0.65

Performance and typical results with the present configuration of the Battelle Rotating Crystal time-of-flight spectrometer are presented along with future improvements. NSA

N68-24737*# Westinghouse Electric Corp., Pittsburgh, Pa.
IMPROVEMENT OF OXYGEN PARTIAL PRESSURE SENSOR
William M. Hickam, Robert P. Goldstein, and F. Reid Agnew [1968] 45 p
(Contract NAS1-5924)
(NASA-CR-66618) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A miniature flight type calcium stabilized zirconia solid electrolyte oxygen sensor has been further studied toward making it applicable to oxygen monitoring of life support environment in capsule systems. Parameters associated with the electrical reliability of the sensor have been studied, feasibility of using a hermetically sealed gaseous oxygen reference has been investigated, and a miniature temperature controller designed and tested. A major problem encountered in the present work, not encountered or anticipated based on the prior experience, was that of porosity of the walls of the double bore calcium stabilized zirconia tubes. The inability to obtain nonporous tubing of the established geometry continuously plagued the program. Author

N68-24739# Instituto de Energia Atomica, Sao Paulo (Brazil).
EXPERIMENTAL STUDY OF A CURVED SLIT SLOW NEUTRON CHOPPER AND TIME OF FLIGHT SPECTROMETER
Silvio B. Herdade, Lia Q. Do Amaral, Claudio Rodriguez, and Laercio A. Vinhas Feb. 1967 75 p refs
(IEA-136) CFSTI: HC $3.00/MF $0.65

Characteristics of a curved slit slow-neutron chopper and time-of-flight spectrometer operating at a beam hole are experimentally determined, and the design and operating characteristics are delineated. Corrections for counting losses in the detecting system and multichannel analyzer are treated in detail, and the relative transmission of the chopper is determined as a function of the product of the chopper angular speed and neutron wavelength. By measuring the broadening in the iron Bragg cut-off, the experimental resolution of the spectrometer was obtained. The reliability of the spectrometer was checked by a total cross-section measurement of gold. The FORTRAN programs for time-of-flight data processing and total cross-section computation are also included. B.S.D.

N68-24743# Iowa State Univ. of Science and Technology, Ames.
THE DESIGN, INSTALLATION, AND OPERATION OF AN AUTOMATIC NEUTRON DIFFRACTION SYSTEM
D. J. Dahm and R. A. Jacobson Dec. 1967 28 p refs
(Contract W-7405-ENG-82)
(IS-1740) CFSTI: HC $3.00/MF $0.65

A Hilger-Watts four circle neutron diffractometer operates under the control of an SDS 910 computer. The interfacing and programming for the system are of local origin. A neutron beam forming an angle of 90° with the incident beam is taken from the beryllium monochromating crystal located inside the reactor face. Alignment of the diffractometer, both optically and with neutrons, the neutron detection devices, and other aspects of the system are discussed in some detail. Author (NSA)

N68-24761*# General Electric Co., Schenectady, N. Y. Research and Development Center.
QUANTITATIVE LEAK TEST DESIGN GUIDE Final Report, 8 Dec. 1966–7 Aug. 1967
J. L. Manganaro and P. L. Hollinger Aug. 1967 40 p Prepared for JPL
(Contracts NAS7-100; JPL-951763)
(NASA-CR-94788; S-67-1128) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A calibrated enclosure system for determining leak rates is discussed, and three different methods for estimating leakage with this system are outlined. These are: (1) a comparison method, in which the test leak is directly compared with a calibrated leak; (2) a superposition method, in which the ratio of the rate of increase for the test leak and the combined calibrated and test leaks is an indication of the test leak rate; and (3) an injection method, in which the rate of helium increase in the enclosure is determined, and then the enclosure calibrated by injecting a known amount of helium. Tests were conducted on such system characteristics as circulation and diffusion of helium, system linearity, system stability, the effect of leak and proper position, and system sensitivity. Results indicate that the injection method is the easiest and most rapid. Leaks ranging from 14.4 to 99.2 cubic centimeters per hour were detected with an average accuracy of 10 percent; testing times ranged from 2 to 4 hours. M.G.J.

N68-24819# Defence Standards Labs., Maribyrnong (Australia).
A CLOSED-CIRCUIT TELEVISION SYSTEM FOR INSTRUMENT READING
B. A. J. Clark, J. Wilbur-Ham, and L. G. Wilson May 1968 8 p refs
(Rept.-313) CFSTI: HC $3.00/MF $0.65

A closed-circuit television system is described for routine calibration work on precision electrical indicating meters that have the usual arrangement of a mirror for avoiding parallax error. The television system is compared with a conventional optical projector used for meter reading, and found to be superior in screen luminance, depth-of-focus, length of scale shown with negligible parallax, and convenience of use. Mechanical arrangements for displaying various parts of curved scales are discussed. Author

N68-24856# Aeronautical Research Council (Gt. Brit.).
ON THE FORMATION OF WHITE-LIGHT FRINGES IN A MACH–ZEHNDER INTERFEROMETER
H. K. Zienkiewicz London HMSO 1968 22 p refs Supersedes ARC-26635, X66-10975
(ARC-R&M-3532; ARC-26635) HMSO: 10s

A theoretical investigation is made of the effects of dispersion in neutral gases on the formation of white light fringes in an ideal Mach–Zehnder interferometer. It is found that the shift of the brightest fringe is determined by the change of the group refractive index at an effective mean wavelength of the white light. However, the white light fringe technique may be used to measure changes of the phase refractive index, provided that an allowance is made for the drift of the brightest fringe caused by the effects of dispersion. Such allowance is needed whenever the fringe shift exceeds about 10. Author

N68-24903# Aeronautical Inspection Directorate, Harefield (England).
AN EXTENSOMETER CALIBRATING RIG
V. H. Cripps and J. F. Stoddart Aug. 1967 20 p refs
(AID-METRO/12) CFSTI: HC $3.00/MF $0.65

An extensometer calibrating rig has been designed which can be easily transported thus enabling autographic extensometers to be calibrated adjacent to their tensile testing machine. A high sensitivity transducer has been used which permits extensometers to be calibrated over ranges up to 0.025 ins accurately and quickly. Author

N68-24920# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).

A SLOW NEUTRON CHOPPER TIME OF FLIGHT SPECTROMETER

V. Dimic and J. Petkovsek Nov. 1967 19 p refs

(NIJS-R-515) CFSTI: HC $3.00/MF $0.65

The principal features and performance of a time of flight spectrometer at a low thermal flux reactor are discussed. The instrument obtains neutron bursts by a slow chopper of a Fermi type with curved slits and measures the neutron travel time along the flight path by multichannel analyzer. Time of flight spectrometer results of measurement on Ca–Sr at scattering angle of 90° are included. G.G.

N68-25049# Brookhaven National Lab., Upton, N. Y. Instrumentation and Health Physics Dept.

CONTINUOUS LOW LEVEL LEVEL ENVIRONMENTAL MEASUREMENT OF ^{41}Ar AND OTHER RADIOACTIVE NOBLE GASES

P. S. Littlefield, A. P. Hull, J. W. Baum, and M. E. Smith [1968] 25 p refs Presented at Symp. on Environ. Surveillance in the Vicinity of Nucl. Facilities, Augusta, Ga.

(BNL-12154; CONF-680108-9) CFSTI: HC $3.00/MF $0.65

A pressurized beta scintillation monitor capable of the continuous measurement of the small concentrations of radioactive gases which might be encountered in the environment in the vicinity of reactors and other nuclear facilities was designed. Although it can be operated up to 1,000 psig, testing to date has been conducted at 120 psig. At this pressure the monitor's sensitivity to ^{41}Ar is 2.9×00 $^{10}cpm/\mu Ci/cm^3$ The monitor has been employed to verify calculations of hourly average normalized gound level (χ/Q) concentrations of the effluent ^{41}Ar from the BGRR stack. Close agreement between calculated and measured concentrations has been achieved at a location 1,330 meters from the point of release. Author (NSA)

N68-25134# Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany).

TWO SIMPLE NEUTRON DETECTORS FOR RADIATION PROTECTION USE [ZWEI EINFACHE NEUTRONENSTRAHLUNGMESSGERAETE FUER DIE STRAHLENSCHUTZPRAXIS]

W. Kiesewetter and J. Steuer Jan. 1968 39 p refs In GERMAN; ENGLISH summary

(SZS-2/68)

Two neutron rate meters for radiation monitoring in working areas are described. The devices allow a reading in units of dose-equivalent rates for a wide neutron energy range and possess a good discrimination of gamma-radiation. The two ratemeters were constructed on the basis of commercially available gamma-dose rate meters. As detectors a BF_3-counter tube and a B_2O_3–ZnS(Ag)-scintillator in DePangher double-moderator technique arrangement are used. Some experimental data are reported. Author (NSA)

N68-25157 Pennsylvania State Univ., University Park.

DISPERSION, LINE PROFILES, AND EFFICIENCY OF A HIGH RESOLUTION SPECTROMETER

Jack Abraham Lowenthal (Ph.D. Thesis) 1966 79 p

Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-1941

The use of a high resolution grating spectrometer in the near infrared region requires a detailed knowledge of certain performance characteristics of the instrument. It is the purpose of this thesis to describe methods whereby these characteristics may be obtained and applied to particular experimental situations. The dispersion of the grating across its blaze was measured in both single and double pass through the use of a Fabry–Perot interferometer. Constants through which one may obtain the single and double pass dispersion in any region of the grating blaze were then calculated. A theoretical expression for the ratio of single to double pass disperions when the spectrometer is used in a slightly non-Littrow arrangement was derived and checked experimentally. This expression is useful for obtaining the double pass spectral slit width. Dissert. Abstr.

N68-25160# United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center.

DEVELOPMENT OF A CONTINUOUS ELECTROCHEMICAL METER FOR OXYGEN IN SODIUM Final Report

B. Minushkin and M. Kolodney 15 Dec. 1967 167 p refs

(Contract AT(30-1)-2877)

(UNC-5131) CFSTI: HC $3.00/MF $0.65

A practical on-line instrument developed for continuously measuring the oxygen content of sodium is described. The meter is based on a galvanic cell with a ThO_2–Y_2O_3 solid electrolyte and a reversible oxygen Cu, Cu_2O reference electrode. The cell develops a voltage which is dependent on the thermodynamic activity (or effective concentration) of oxygen in the sodium. The oxygen meter consists of three major components: an electrode assembly, a housing, and a voltage indicator. The electrode assembly in contact with sodium forms the galvanic cell. The housing provides the means for exposing the electrode assembly to flowing sodium and also provides a stainless steel containment envelope for the electrode assembly. The voltage indicator measures the cell voltage and provides output signals to operate a recorder and alarms which indicate excessive changes in oxygen content or cell breakage. NSA

N68-25175# Institutt for Atomenergi, Halden (Norway).

CALIBRATION TECHNIQUES AND DATA HANDLING EQUIPMENT FOR INSTRUMENTED FUEL ASSEMBLIES IN HBWR

B. Aarset Dec. 1967 63 p refs

(HPR-79)

In HBWR measurements of coolant flow and temperatures in instrumented fuel channels are used to determine assembly power for the purpose of calibrating the power indicators, gamma thermometers and beta current neutron detectors, which are essential for the study of various fuel assembly parameters related to assembly power, such as channel hydraulics, burn-up, burn-out, and fuel temperatures. Various methods are used for the power measurement depending on the coolant condition in the channel: no boiling, various degrees of boiling as controlled through subcooling, or high outlet steam qualities with no subcooling. Accuracies in the order of ±3–5% are achieved. Careful out-of-pile and in-pile calibration and checking of various instruments are performed prior to the power measurements. To handle the signals from about 40 instrumented fuel assemblies installed in the reactor, extensive rationalizing of the data handling system has been arranged. The handling system comprises traneducer electronics, recorders, analogue computer, data logger with electronic multiplexer and A/D converter, magnetic tape recorder, and a digital computer. All in-core signals and various parts of the data processing equipment are terminated on a special terminating rack. Author (NSA)

N68-25202# Army Electronics Labs., Fort Monmouth, N. J. Avionics Lab.

RADAR ALTIMETER TECHNIQUES IN THE ARCTIC ENVIRONMENT

R. J. Lukas and R. C. Cruickshank *In* AGARD Sub-Surface Commun. 1966 p 339–354 refs (See N68-25187 14-07)

Experiments recently conducted in the Arctic region have confirmed that the electrical properties of polar ice and snow do, in fact, cause microwave frequencies to suffer high surface reflection losses, and low transmission losses within the medium. These results correlate well with theoretical predictions. In many instances sub-surface interfaces provide signal reflections which are of substantial amplitude and are readily detectable at the radar altimeter receiver. Findings further showed that radar altimeters employing nanosecond pulse leading-edge-tracking techniques are significantly more accurate than those utilizing frequency modulation. Specifically, CW altimeter errors as great as 150 ft were recorded for an actual altitude of 300 ft. Pulse altimeter errors were considered negligible; in fact, they were not measurable since they did not exceed the instrumentation error inherent in the experiment. Author

N68-25220*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
MISSION B EXPERIMENT DATA STORAGE AND RADIATION STUDIES
G. B. Holmes et al 5 Sep. 1967 76 p refs
(Contract NAS8-21003)
(NASA-CR-61822; LMSC-A842321) CFSTI: HC $3.00/MF $0.65 CSCL 14E

In order to increase cluster shield radiation protection of films during prolonged space missions, plus x films and type 103-0 films were studied for effects of streaming flux upon total radiation damage to the spar mounted films. Dose estimates were made for a variety of parametric conditions and film dose versus shield weight values were obtained for side mounted and aft mounted camera configurations are given. G.G.

N68-25231 Utah Univ., Salt Lake City.
CYLINDRICAL SPARK COUNTERS AND MUON AIR SHOWERS
Jack Lindsay Parker (Ph.D. Thesis) 1967 63 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-3226

A cylindrical spark counter (CSC) has been developed as an element of the neutrino detector. A typical counter is 15 cm in diameter and 11 m long with an 0.25-mm center wire. A gas mixture of 2/3 argon and 1/3 ethylene at a total pressure of 750 torr results in a discharge sharply localized at the location of the initial ionization. Operation in the pulsed mode makes possible economies in construction with a precision of 3 mm. About 1200 events consisting of two or more nearly parallel muons were observed with zenith angles between 45° and 90°. The rate for such events in the prototype detector is $6.8^{+1.0}_{-0.8}$ per hour. The zenith angle distribution is of the form $1 \propto h(\theta)^{-2.0}$ where $h(\theta)$ is the distance to the point at which the cosmic ray primaries have traversed 400 g/cm^2 at zenith angle θ. Dissert. Abstr.

N68-25254# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
ON THE APPLICATION OF SEMICONDUCTOR DETECTORS IN THE X-RAY FLUORESCENCE ANALYSIS [ISPOL'ZOVANIE POLUPRROVODNIKOVYKH DETEKTOROV DLYA EMISSIONNOGO RENTTENOVSKOGO ANALIZA]
V. Pshiborski, Ya. Khvashchevska, V. Charnatski, and M. Shimchak 1967 16 p refs In RUSSIAN; ENGLISH summary
(INR-820/II/PS)

Some preliminary results on the possible application of semiconductor detectors for the qualitative X-ray fluorescence analysis are presented. Characteristic X-ray spectra of Mo, Ag, In, Sn, Ce, Au, Pt, Ta, and W excited by γ-rays from ^{241}Am and ^{57}Co sources are presented. Author (NSA)

N68-25266# General Electric Co., Philadelphia, Pa. Missile and Space Div.
RESEARCH ON AVALANCHE TYPE SEMICONDUCTOR RADIATION DETECTORS Annual Report, Jan.–Dec. 1967
Gerald C. Huth and Robert J. Locker Jan. 1968 130 p refs
(Contract AT(30-1)-3246)
(NYO-3246-TA-1) CFSTI: HC $3.00/MF $0.65

Developments in fabrication techniques and performance of avalanche semiconductor detectors are reported. Also, uses of avalanche detectors for tritium detection and biomedical applications are discussed. NSA

N68-25273# National Bureau of Standards, Washington, D. C.
STANDARD NUCLEAR INSTRUMENT MODULES
Louis Costrell Jan. 1968 31p
(TID-20893, Rev. 2) GPO: $0.25

Specifications for standard nuclear instrument modules are presented to assure mechanical and electrical interchangeability of modules. Bin and power supply specifications are included. NSA

N68-25288*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN EVENT RECORDER FOR OBTAINING MISSILE HEAT-SHIELD ABLATION DATA
James M. Russell, III 14 Sep. 1967 Presented at the 22d Conf. Chicago, 11–14
(NASA-TM-X-60497) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A miniature 84-channel event recorder designed to record in-flight measurements of heat-shield ablation was developed. The flight data which are a series of times at which flight events occurred are stored in the instrument and read out after recovery of the reentry payload. The instrument consists of a metallic recording disk rotated at a constant speed by a spring-driven motor, and fuse wire marking elements which mark the disk when an event occurs. This paper describes the principle of operation, the design and construction, and the results of the tests conducted in the event recorder development. Author

N68-25290*# California Univ., Los Angeles. Space Biology Lab.
A SOLID STATE PULSED COAGULATING DIATHERMY INSTRUMENT
P. G. Petty, A. J. Lim, and R. Stahl [1967] 10 p refs
(Grants NsG-237-62; NIH 1-P07-FR00257)
(NASA-CR-84757) CFSTI: HC $3.00/MF $0.65 CSCL 06L

The design of the instrument, which includes a bipolar forcept configuration for coagulation, is described, and initial experimental data are presented. The ability of obtaining hemostasis and coagulating tissue was demonstrated in living tissue of anesthetized cats and rats. Results of varying the voltage, pulse width, and repetition rate parameters separately are discussed. The advantages of this instrument over spark gap instruments are identified as lower power requirement, smaller physical size, lessened fire danger, and elimination of EKG interference. N.E.N.

N68-25316*# Ling–Temco–Vought, Inc., Dallas, Tex. LTV Research Center.
INVESTIGATION OF THE CALIBRATION OF MICROPHONES FOR SONIC BOOM MEASUREMENT
John J. Van Houten and Ron Brown Washington, D. C. NASA Jun. 1968 60 p refs
(Contract NAS1-5652)
(NASA-CR-1075; TR-0-71200/7TR-112) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Examination of the various procedures available for microphone calibration indicated that application of the electrostatic actuator

technique and the use of an infrasonic pistonphone would satisfy NASA's microphone calibration requirements. These instruments provide the equipment necessary for a comprehensive evaluation of microphones currently being used by NASA as well as those which may be used in the future. The system is capable of sinusoidal evaluation of the frequency response and sensitivity of a microphone over the range of 0.01 Hz to above 20 kHz. Sinusoidal sound pressure levels of 94 dB and 114 dB are achieved with the infrasonic pistonphone and sound pressures in excess of 128 dB are obtained by use of the electrostatic actuator system. The calibration procedure demonstrates the compatibility of steady state and transient response characteristics of the microphone and provides illustrations of idealized N-waveform measurement capability of currently available microphones and complementing instrumentation. Author

N68-25317*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

CHARACTERISTICS AND USE OF X-15 AIR-DATA SENSORS

Lannie D. Webb Washington, D. C. Jun. 1968 59 p refs

(NASA-TN-D-4597) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The uses, techniques of correlation, and analysis of flight-guidance and air data sensors that have been flown on the X-15 airplane are examined. Methods by which meteorological balloons and high altitude rocketsondes were used to define the atmospheric envelope around the X-15 airplane are discussed. The application of onboard sensor data, meteorological data, and radar data in obtaining altitude, velocity, Mach number, and dynamic pressure is explained. Onboard systems considered are the nose-boom pitot-static tube, hypersonic flow-direction sensor (ball nose), fuselage static system, fuselage pitot probe, stagnation-temperature probe, and inertial flight-data system. Author

N68-25328*# National Aeronautics and Space Administration, Flight Research Center, Edwards, Calif.

ADVANCED AIR DATA SENSING TECHNIQUES

Rodney K. Bogue and Lannie D. Webb Mar. 1968 56 p refs Presented at 5th Internatl. Aerospace Instrumentation Symp., Cranfield, Engl., 25–28 Mar. 1968

(NASA-TM-X-61115) CFSTI: HC $3.00 CSCL 14B

Flight evaluation data are presented on the use of a fluidic temperature sensor for measuring total temperature on the X-15 aircraft travelling at hypersonic speeds within the atmosphere. The oscillator in the fluidic sensor is described as an adaptation of a bistable fluid amplifier; the tendency of the fluid stream to attach itself to a nearby wall (the Coanda effect) forms the basis of operation. Laboratory calibration checks and simulation tests are discussed, and details are given on the X-15 sensor mount and cooling equipment. Procedures for flight data recording and reduction are outlined. Discrepancies between the shielded thermocouple measurement of total temperature and the fluidic probe measurement are analyzed, and problem areas are identified. It is concluded, however, that the flight test data establish the feasibility of fluidic temperature sensors. M.G.J.

N68-25344*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

METHODS FOR CALIBRATING MOTION MEASURING TRANSDUCERS AT LOW FREQUENCIES (ZERO TO 20 Hz)

Otis C. Ingebritsen 1967 17 p refs Presented at the 22d Ann. Instr. Soc. of Am. Conf., Chicago, 11–14 Sep. 1967

(NASA-TM-X-60504; L-5794) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The discrete point method and the continuous comparison method of calibrating accelerometers on a centrifuge are discussed. The discrete point method uses an integrating technique to average an accelerometer's output over the same time interval as a counter averages the centrifuge angular velocity. The continuous comparison method produces a linearity correction curve of an accelerometer by a simultaneous comparison with a reference accelerometer. This latter system is accurate, saves time, and is more likely to detect anomalous dispersion characteristics. The three-dimensional rotator method for the calibration of inertial angular transducers is also discussed. An angular transducer is mounted in a two-gimbal frame with its sensitive axis perpendicular to the axis of the inner gimbal. The two gimbals are simultaneously rotated about their mutually perpendicular axes at angular velocities of ω_1 (outer gimbal) and ω_2 (inner gimbal). Author

N68-25355# Uppsala Univ. (Sweden). Inst. of Physics.

A PHOTOELECTRIC MICROCATOR FOR RAPID MEASUREMENTS [EN FOTOELEKTRISK MIKROKATOR MED MOEJLIGHET TILL SNABBA MAETNINGAR]

Anders Svaerd Stroem Nov. 1967 10 p refs In SWEDISH

(UUIP-560)

A photoelectric microcator is described. It is used to measure changes in position of bodies linearly in three ranges: $\pm 100 \times 10^{-6}$ m, $\pm 30 \times 10^{-6}$ m, and $\pm 10 \times 10^{-6}$ m. NSA

N68-25375*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MONOMOLECULAR CONTAMINATION OF OPTICAL SURFACES

H. Shapiro and J. Hanyok Washington Jun. 1968 25 p refs

(NASA-TN-D-4612) CFSTI: HC $3.00/MF $0.65 CSCL 20F

This paper describes the measurement of ultraviolet reflectance change in mirrors, caused by oil contamination. Spacecraft equipped with such mirrors are tested in a vacuum generated by oil diffusion pumps. Within instrumental limits, our experimental mirrors show no change in reflectivity when the vacuum chamber is operated in the usual mode. Contamination is plotted against amount of oil deposited, the amount being measured by a quartz-crystal microbalance. The observed phenomena give a more complete picture of the contamination process than existed previously. Deposited oil, it is found, forms minute droplets on the surface of mirrors coated with MgF_2. The droplets can be evaporated from the surface at a much higher chamber pressure than the rated vapor pressure of the bulk liquid; this provides a way of cleaning the mirrors. It is possible to operate diffusion-pumped systems so as to minimize contamination. Author

N68-25384# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

COUNTER, 4π PROPORTIONAL, FOR ABSOLUTE MEASUREMENT OF OF β-EMITTERS [COMPTEUR 4π PROPORTIONNEL DESTINE A LA MESURE ABSOLUTE D'EMETTEURS β]

Jean-Pierre Perolat and Michel Laine Oct. 1967 17 p refs In FRENCH

(CEA-R-3362)

The design and performance of a 4π counter for measuring beta activity are presented. The characteristics of this detector allow flexibility of use, particularly a possibility of adaption in a β,γ coincidence unit. Author (NSA)

N68-25390# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

CONTRIBUTION TO β-EMITTER SPECTROMETRY USING JUNCTION DETECTORS: STUDY OF ^{35}S, ^{45}Ca, ^{204}Tl, ^{36}Cl [CONTRIBUTION A LA SPECTROMETRIE DES EMETTEURS β A L'AIDE DE DETECTEURS A JONCTION: ETUDE DES SPECTRES DU ^{35}S, ^{45}Ca, ^{240}Tl, ^{36}Cl]

Fernand Hareux Oct. 1967 91 p refs In FRENCH

(CEA-R-3315)

The possibilities of using beta spectrometers equipped with semiconductor detectors were explored. The optimum operating

conditions and beta detection efficiencies of two types of junctions, surface-barrier and lithium-compensated, were examined. The resolving power was determined as a function of the polarization voltage. The time constants of the circuit and of the temperature were also determined. The beta spectra of ^{35}S, ^{45}Ca, ^{204}Tl, and ^{36}Cl under the best possible operational conditions were measured. An attempt was made to find a linear curie representation, as extended as possible, for each of these spectra. The maximum energy of the radioisotopes deduced from the curie representation was found to be: ^{35}S, 166±1 keV; ^{45}Ca, 259±2 keV; ^{204}Tl, 760±4 keV; and ^{36}Cl, 708±4 keV. NSA

N68-25391# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
NUMERICAL ICTOMETER WITH LARGE TIME CONSTANT FOR VERY LOW COUNT RATES: OPERATIONAL RESULTS [ICTOMETRE NUMERIQUE A GRANDE CONSTANTE DE TEMPS POUR TRES FAIBLE TAUX DE COMPTAGE: RESULTATS D'EXPLOITATION]
Josef Kaiser Nov. 1967 16 p In FRENCH
(CEA-R-3340)

The use of an analog ictometer poses technical problems for measuring low count rates. These latter call for time constants of up to 1000 sec. The numerical technique is better adapted and makes it possible to increase the time constant to 1000 sec or over. The equipment described consists of 6 numerical ictometers fitted in a 3 U 3 drawer. By means of a clock it is possible to vary the counting time from 1 second to 1000 seconds, using values at 5, 10, 50, 100 and 500 seconds. The corresponding values of the frequency are 500 c/sec, 100, 50, 10, 5, 1 and 0.5 c/sec with a resolving power of 0.2 percent. The results appears on an indicator panel (galvanometer) and is available in the form of an analogue voltage suitable for a 50 mV MECI recorder. Author (NSA)

N68-25395*# Aztec School of Languages, Inc., Acton, Mass.
USING CASCADE ELECTRON IMAGE CONVERTERS FOR STUDYING INFRARED LUMINESCENCE IN THE UPPER ATMOSPHERE
T. I. Toroshelidze and L. M. Fishkova Washington NASA [1966] 8 p refs
(Contract NASw-1692)
(NASA-TT-F-11574) CFSTI: HC $3.00/MF $0.65 CSCL 20F

Use of electron-image converters (EIC) is explained as it applies to the study of infrared luminescence in the twilight and night skies of upper atmosphere. Details of the method are included, and it is noted that the afterglow of the shielding is a problem in terms of the quality of the spectra obtained. A spectral characteristic curve shows the spectral sensitivity of the EIC photocathode plus absorption in the spectrograph and in the transferring optic. M.W.R.

N68-25397# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
SI(LI)-DETECTORS AND PREAMPLIFIER FOR HIGH RESOLUTION SPECTROMETRY OF CONVERSION ELECTRONS AND X-RAYS [SI(LI)-DETEKTORY I PREDUSILITEL DLYA SPEKTROMETRII S VYSOKIM RAXRESHENIEM KONVERSIONNYKH ELEKTRONOV I RENTGENOVSKOGO IZLUCHENIYA]
V. F. Kushniruk Bachone, V. G. Subbotin, Z. A. Ter-akop'yan, Yu. P. Kharitonov, and Zung Sam Zo 1968 14 p refs In RUSSIAN
(JINR-P13-3718)

The method of designing Si(Li) detectors and preamplifiers for the spectroscopy of X-rays and conversion electrons is described. The X-ray spectra of ^{241}Am and ^{109}Cd sources as well as those of internal conversion electrons of ^{137}Cs and ^{109}Dc are given. The resolution (fwhm) for X-rays of ^{241}Am is equal to 0.92 keV and for the conversion electrons of ^{137}Cs 2.5 keV. Author (NSA)

N68-25414*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A RADIATION METHOD OF IMPROVING THE TEMPERATURE CHARACTERISTICS OF SILICON SEMICONDUCTOR STRAIN GAGES
Chris Gross [1967] 18 p refs Presented at the 22d Ann. Instr. Soc. of Am. Conf. and Exhibit, Chicago, 11–14 Sep. 1967
(NASA-TM-X-60498) CFSTI: $3.00 CSCL 14B

The thermal coefficient of resistance (TCR) of n- and p-type silicon semiconductor strain gages may be substantially reduced by irradiating them with 2 MeV electrons. The thermal coefficient of gage factor (TCGF) may also be reduced in some resistivities of irradiated n-type gages. The reduction results from the majority carrier concentration increasing with temperature and, hence, compensating for the usual decrease in carrier mobility with temperature. This method has been applied to n- and p-type gages fabricated from silicon of several different resistivities. The reduction was found to depend on the type and resistivity of the material and the ingrated electron flux. The largest reduction in TCR occurred in the irradiated 0.045 ohm-cm n-type and 10 ohm-cm p-type silicon gages. The TCR of these gages after irradiation was approximately 1%/100°C in the temperature interval from 0°C to 100°C, or about a factor of 40 to 50 times smaller than their preirradiated value. The TCGF of these same gages was slightly reduced after irradiation. The absolute value of the gage factor was reduced by only about 5% of its original value. The irradiated gages could be operated at 150°C for extended periods without a noticeable change in the postirradiated values of the TCR or TCGF. Author

N68-25422*# Geological Survey, Washington, D. C.
UTILIZATION OF MULTIBAND AERIAL PHOTOGRAPHS IN URBAN HOUSING QUALITY STUDIES
Barry S. Wellar (Northwestern Univ.) May 1968 23 p refs
(NASA Order R-09-020-015)
(NASA-CR-94776; NASA-120) CFSTI: HC $3.00/MF $0.65 CSCL 08F

The collection and utilization of urban data pose problems for many scientists. Present data collection procedures are frequently expensive, slow, and subject to considerable error. The data generally do not meet the basic requirements of timeliness, flexibility, compatibility and reliability. This paper represents an initial thrust towards generating housing quality data from multiband aerial photographs which meet the above requirements. The study compares the extracted data with those used in the American Public Health Association survey appraisal form. This form is currently being examined by the U.S. Bureau of the Census as a potential basis for the 1970 Census of Housing. Author

N68-25444# California Univ., Berkeley. Lawrence Radiation Lab.
HYPERCRYOGENIC DETECTOR FET UNIT: CORE OF A HIGH RESOLUTION SPECTROMETER
E. Elad and M. Nakamura 7 Feb. 1968 20 p refs Presented at 11th Scintillation and Semicond. Counter Symp., Washington, D. C., 28 Feb.–1 Mar. 1968
(Contract W-7405-ENG-48)
(UCRL-17901; CONF-680207-2) CFSTI: HC $3.00/MF $0.65

A hypercryogenic high-resolution X-ray and γ-ray spectrometer is described. The spectrometer consists of a lithium-drifted germanium detector and a germanium-junction field-effect transistor (JFET) preamplifier. The detector is operated at its optimum temperature, which is in the range of 10–30°K. The JFET's are operated at liquid helium temperature. This results in 0.28 keV FWHM preamplifier resolution with a slope of 0.018 keV/pF.

Resolutions of the order of 0.4 keV are obtained with low capacitance detectors for low-energy X-rays. The γ-rays of ^{57}Co are measured with 0.68 keV FWHM. The described spectrometer was used to study some aspects of the trapping effects in germanium detectors. Author (NSA)

N68-25454# California Univ., Livermore. Lawrence Radiation Lab.

TESTING THE SURFACE-FOLLOWER WAVE-HEIGHT MEASURING SYSTEM

R. J. Stinner, R. M. Snyder, and K. H. Olsen 18 Jan. 1968 19 p refs

(Contract W-7405-ENG-48)

(UCRL-50379) CFSTI: HC $3.00/MF $0.65

The testing of an advanced system for measuring the height and period of deep-ocean waves is described. An instrumentation buoy containing power supplies and data recording equipment is tethered to a second buoy which was previously anchored in the deep-ocean region of interest. Suspended 965 ft below the instrumentation buoy is a sensor housing, containing a vibrating-wire pressure transducer. By taking advantage of the hydraulic filtering of the shorter periods at the sensor depth, it is possible to measure waves of nominal height (>6 in.) having periods as long as 100 sec. Preliminary results are shown and discussed. Author (NSA)

N68-25457# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany).

POSITION DETERMINATION OF A STATIONARY TV COMMUNICATIONS SATELLITE WITH HORIZON SENSORS [LAGEBESTIMMUNG EINES STATIONAEREN FERNSEHR-UNDFUNKSATELLITEN MIT HORIZONTSENSOREN]

W. Scharf Dec. 1967 33 p refs In GERMAN; ENGLISH summary

(DLR-Mitt.-67-21) CFSTI: HC $3.00/MF $0.65

Physical characteristics and operational principles of conical rotating scan sensors, periphery scanners, and particularly, linear scanners and edge trackers are briefly examined. Accuracy and service life of the scanners are evaluated in order to determine their suitability as attitude sensors in a stationary television broadcasting satellite. The use of a star tracker in such a satellite is also considered. Transl. by K.W.

N68-25460# Portugal. Nuclear Energy Commission, Sacavem. Nuclear Reactor Div.

AUTOMATIC COMMUTATOR OF LEVELS [COMMUTATEUR AUTOMATIQUE DE GAMMES]

J. Menezes 1966 10 p refs In FRENCH Submitted for publication

(LFEN-NI.30(β)) CFSTI: HC $3.00/MF $0.65

An automatic level commutator was studied that used an amplifier with direct continuous linear current for neutron control in nuclear reactors. The commutator is adaptable to other nuclear physics applications that require a linear measure of continuous current at many levels. The current of the detector can vary between 10^{-11} Å and 10^{-4} Å, and the device can be used at eight levels that require the commutation of resistance of the counter-reaction. To evaluate at the 10^{-11} Å level, an insulation resistance on the order of 10^{13} Ω is required to get a measure considered to be within 1% accurate. Three circuits are described that work automatically. One is an electromechanical solution, the next uses solid thyratrons and relays interrupted by flexible thin plates, and the third replaces the thyratrons with logic circuits. Transl. by M.W.R.

N68-25465*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

DESIGN AND APPLICATION OF A PHOTOMULTIPLIER DETECTION SYSTEM FOR ARTIFICIAL METEORS

Wendell G. Ayers 11 Aug. 1967 7 p refs Presented at the Soc. of Photo-Opt. Instrumentation Engr. 12th Ann. Tech. Symp., Los Angeles, 7–11 Aug. 1967

(NASA-TM-X-60408; L-5669) CFSTI: $3.00 CSCL 14B

Constraints governing the design of an electro-optical device using a photomultiplier tube as a detector are discussed in terms of multiple reentries, uncertainty in reentry positions, and the inability to track individual reentries. In the basic design chosen, the use of imaging optics permitted the development of a compact, portable instrument, and provided a method of discriminating between reentry source and stellar background. The photomultiplier tube was selected on the basis of desired sensitivity, a spectral response similar to the photographic emulsions, and a photocathode surface large enough to accommodate the field of view of the objective lens. Also discussed are the modifications made to the basic instrument to improve its performance characteristics, and to increase its dynamic range. M.G.J.

N68-25518*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AN AUTOCORRELATION APPROACH TO THE BROWN–TWISS INTERFEROMETER

Frank C. Jones Washington May 1968 29 p refs

(NASA-TN-D-4480) CFSTI: HC $3.00/MF $0.65 CSCL 20F

Consideration is given to interference phenomena which occur with light produced by incoherent sources. Starting from the familiar interference pattern produced by two coherent sources, one can proceed in simple steps to a picture of two incoherent sources producing an interference pattern that moves about at random. This randomly moving pattern leaves behind a footprint in the form of the intensity autocorrelation function. This report describes how the autocorrelation function for an extended, incoherent source may be constructed. It is this function that is measured by the Brown–Twiss stellar interferometer. Author

N68-25554*# Geological Survey, Washington, D. C.

REMOTE SENSOR IMAGERY IN URBAN RESEARCH: SOME POTENTIALITIES AND PROBLEMS

Eric G. Moore and Barry S. Wellar (Northwestern Univ.) May 1968 32 p refs

(NASA Order R-09-020-015)

(NASA-CR-94782; NASA-118) CFSTI: HC $3.00/MF $0.65 CSCL 08F

In evaluating the potential of a new technique of urban data collection attention must be paid to existing needs. The first part of the paper considers a number of requirements that should be satisfied by urban data if a sound base for planning and research is to be provided. The second part describes the properties of remote sensors and discusses the extent to which (1) they generate data which are compatible with the specified requirements, and (2) they might help to reduce current urban data deficiencies. Finally, the potentialities of three sensor types (the multiband camera, thermal infrared sensors, and imaging radars) in specific areas of urban research are assessed. Author

N68-25563# University of Southern Calif., Los Angeles.

HIGH-FREQUENCY MICROPHONE CALIBRATION USING A SUPERSONIC FREE-FLIGHT RANGE

Charles D. Hayes and Raymond C. Binder *In* NRL The Shock and Vibration Bull., No. 37, Pt. 2 Jan. 1968 p 7–12 refs (See N68-25561 14-32)

A method using a supersonic free-flight range was developed for the calibration of microphones over a wide frequency range. The apparatus includes a gun and a test section for measuring projectile speed and taking shadowgraph pictures. Material on the properties of shock pulses developed by supersonic projectiles is presented. The N-type shock wave developed by the supersonic projectile provides the input shock pulse acting on the microphone

face. Using a digital computer program, a Fourier transform of the microphone output (from an oscilloscope trace) is combined in a particular manner to calibrate the microphone over a range of frequencies. The results of this technique show real promise for frequencies up to 100,000 Hz. Author

N68-25565# Boeing Co., Seattle, Wash.
CALIBRATION OF ACCELEROMETERS BY IMPULSE EXCITATION AND FOURIER INTEGRAL TRANSFORM TECHNIQUES
John D. Favour *In* NRL The Shock and Vibration Bull., No. 37, Pt. 2 Jan. 1968 p 17–27 refs (See N68-25561 14-32)

A new technique for the dynamic calibration of accelerometers has been developed. It is based upon digital computer calculation and ratioing of the Fourier integral transforms of the test accelerometers output signal and of standard accelerometer output signal when excited by an acceleration impulse. The basic technique is completely outlined. The system was tested and shown to be faster, cheaper, more accurate, and more versatile than the conventional sinusoidal excitation technique. The design, fabrication, and initial testing of an impulse exciter are discussed. Author

N68-25566# Naval Ordnance Lab., White Oak, Md.
BIDIRECTIONAL SHOCK AND HIGH-IMPACT EFFECTS ON SHOCK TRANSDUCERS
V. F. De Vost and P. S. Hughes *In* NRL The Shock and Vibration Bull., No. 37, Pt. 2 Jan. 1968 p 29–42 refs (See N68-25561 14-32)

Naval Ordnance Laboratory has observed frequent signal errors in recordings of shock produced by underwater explosions, firing of artillery projectiles, and actuation of pyrotechnic devices. Similar errors have been observed in recordings of shock produced by laboratory testers used to simulate the effects of shipboard shock, hard-target impact, and projectile setback. A laboratory investigation of the problem has traced the source of signal error to the piezoelectric shock transducer and has identified some of the characteristics of shock which adversely affect transducer response: the shocks contain very high frequencies and some are bidirectional. Author

N68-25567*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
INFLUENCE OF FIXTURE STRESS CONCENTRATIONS ON RING ACCELEROMETERS
James A. Nagy and Charles E. Henley, Jr. *In* NRL The Shock and Vibration Bull., No. 37, Pt. 2 Jan. 1968 p 43–50 refs (See N68-25561 14-32)

Tests have revealed that the most commonly used base-strain-free accelerometer in use at the Goddard Space Flight Center is subject to a subtle source of error from strains developed in vibration fixtures. Accelerometers mounted on supposedly rigid surfaces may show errors of the order of 100 percent at the very low frequencies below any resonances. A study to determine the nature of the fixture stress concentration and means of avoiding it was initiated. The test methods used and the results obtained are described. The test methods discussed include (a) standard accelerometer calibration techniques as well as calibrations varying torque, position, and mounting hole angle; (b) photoelastic techniques; (c) base sensitivity checks; and (d) a transducer devised to detect the presence of base strain in mounted accelerometers. Author

N68-25568# Navy Underwater Sound Lab., New London, Conn.
SONAR TRANSDUCER VIBRATION REQUIREMENTS AND MEASUREMENT TECHNIQUES
Gerald M. Mayer and Edward G. Marsh *In* NRL The Shock and Vibration Bull., No. 37, Pt. 2 Jan. 1968 p 51–55 (See N68-25561 14-32)

Vibration characteristics of passive sonar transducer elements have been investigated, and a standard series of measurements has been devised to isolate various portions of the vibration response. The hydrophone vibration response measured at the output terminals of a sonar transducer is composed of an acceleration-induced component, a velocity-induced component, and component resulting from the water-coupled energy radiated from nearby vibrating structural elements. Techniques for experimentally determining the relative contribution of each are discussed. The experimental equipment used at the Underwater Sound Laboratory is briefly outlined, and graphical representations of each of the vibration response components discussed are given for a typical piezoelectric ceramic hydrophone. Author

N68-25570# Naval Ordnance Lab., White Oak, Md.
A COMPACT, LOW-COST SHOCK-SPECTRUM ANALYZER
William W. Mebane *In* NRL The Shock and Vibration Bull., No. 37, Pt. 2 Jan. 1968 p 65–75 (See N68-25561 14-32)

A low-cost, portable shock-spectrum analyzer was designed and built for use in the laboratory and in the field. The analyzer contains three electrical low-pass filters that simulate three single-degree-of-freedom mechanical systems. Each filter has one operational amplifier with associated resistors and capacitors. The natural frequencies and damping coefficients are varied by switching combinations of preselected resistors and capacitors. Twenty-four single-degree-of-freedom systems with natural frequencies from 3.04 to 625 Hz in about one-third octave steps are simulated. Design and operational details of the analyzer are described. A brief development of the one-amplifier, low-pass electrical filter and its application to the mechanical single-degree-of-freedom system is given. The formulas used in selecting network elements are presented. Normal operational procedures, including frequency, damping, and accuracy limitations, are shown. Finally, the spectra from analyzed and theoretical pulses are compared. Author

N68-25594# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
NUMERICAL ICTOMETER WITH VARIABLE TIME CONSTANTS AND INTEGRATED CIRCUITS [ICTOMETRE NUMERIQUE A CONSTANTE DE TEMPS VARIABLE A CIRCUITS INTEGRES]
Josef Kaiser and Jacques Fuan Nov. 1967 23 p In FRENCH
(CEA-R-3331)

This prototype is built entirely of MECL-type integrated circuits from Motorola and is thus contained in two relatively small boxes. Author (NSA)

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N68-24426# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
PRELIMINARY EXPERIMENTAL STUDY ON LOW CYCLE FATIGUE OF FILAMENT-WOUND COMPOSITES
Akira Kobayashi, Nobuo Otani, and Kozo Kawata Mar. 1968 12 p *Its* Vol. 33, No. 6
(ISAS-424, V. 33, No. 6) CFSTI: HC $3.00/MF $0.65

The low cycle fatigue of filament-wound composites is investigated, and the experimental verifications with the ISAS ring test are obtained for a 90% preloading case. Further discussions

concerning the low cycle fatigue phenomenon due to the internal pressure in the rocket motor chamber combustion are made. Author

N68-24456*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COOLING STUDIES WITH 40-MILLIMETER-BORE BALL BEARINGS USING LOW FLOW RATES OF 60°R (33°K) HYDROGEN GAS
David E. Brewe, Harold H. Coe, and Herbert W. Scibbe Washington Jun. 1968 27 p refs
(NASA-TN-D-4616) CFSTI: HC$3.00/MF$0.65 CSCL 13I

Experiments and analyses were performed to determine ball bearing cooling requirments at shaft speeds to 35,000 rpm and thrust loads to 400 pounds (1780 N). A bronze-filled polytetrafluoroethylene retainer was used to lubricate the bearings. Bearing outer-race temperature varied as the inverse of hydrogen gas flow rate through the bearing. From this inverse relation, a minimum flow equation was developed for the range of bearing operating conditions. The minimum flow rate required for bearing cooling was more sensitive to speed than to load increases. Film transfer to the inner-race grooves and retainer wear are indicated and discussed. Author

N68-24502# General Electric Co., Schenectady, N. Y. Research and Development Center.
WINDOW SEALS FOR ULTRAHIGH VACUUM USE
R. W. Roberts, J. F. Harrod, and H. A. Poran May 1967 6 p refs
(Rept.-67-C-165)

Sealing techniques are described for joining windows of lithium fluoride, magnesium oxide, and quartz to Pyrex glass, FN glass, quartz, and silver. These seals will withstand repeated bakeouts at 300° to 350°C and can be used in ultrahigh vacuum systems. Author

N68-24507# Mechanical Technology Inc., Latham, N. Y.
SELECTION AND EVALUATION OF MATERIALS FOR STEAM LUBRICATED BEARINGS
S. F. Murray and F. K. Orcutt 13 Feb. 1968 57 p refs
(Contract AT(30-1)-3839)
(MTI-68-TR-13; NYO-3839-1) CFSTI: HC$3.00/MF$0.65

An experimental study was made to select material combinations for use in steam-lubricated bearings. Major emphasis was placed on the use of wear-resistant plasma coatings, sprayed on corrosion resistant substrates. These coatings have outstanding resistance to damage during high speed rubs, simplify design and fabrication problems, and have shown promise in actual steam bearings. A number of candidate materials and coatings were selected for evaluation. They were solid Stellite 6B, a sprayed Stellite 6 coating, two metal-bonded carbides, two self-bonded oxides, and plain annealed 410 stainless steel. Static erosion tests were run on these materials with the results that nickel chrome-bonded chrome carbide coating gave the best overall results: nickel-bonded carbide on a hardened steel substrate showed good resistance to erosion damage around the feedhole; and Stellite 6 costing was promising for the impingement surface. High speed rub tests were made on nickel chrome-bonded chrome carbide versus itself and stellite coating versus nickel-bonded tungsten carbide. The chrome carbide coating appears to be the best choice for use in steam-lubricated bearings. NSA

N68-24529# General Electric Co., Philadelphia, Pa. Missile and Space Div.
STOCHASTIC THEORY OF REPAIRABLE SYSTEMS
E. J. Muth 15 Jun. 1967 166 p refs
(R67ASD6)

This report develops and analyzes stochastic models of systems whose components can be repaired or replaced. Chapter 2 defines semi-Markov processes, derives some of their important properties, and shows how general multistate models lead to semi-Markov processes. The subsequent analysis focuses on a model in which only two system states are distinguished at any time; the system is either operating (up), or failed and under repair (down). The stochastic behavior in time of the system is then uniquely specified by the probability laws of the random variables time to failure and time to repair, and by the initial conditions at time zero. Chapter 3 discusses families of two-parameter distributions suitable for representing the time to failure and time to repair. Chapter 4 defines several stochastic processes associated with the two-state model. Applications, numerical methods for computing the distribution functions and the moments, and approximations are discussed. Important conclusions are that it is in general sufficient to specify the first two moments of time to failure and time to repair and to assume a distribution which is most tractable analytically, such as the gamma distribution. Author

N68-24588# California Univ., Berkeley. Lawrence Radiation Lab.
RF PLASMA MICROSPHEROIDIZATION OF CERAMICS
Randolph Tilden Tremper (M.S. Thesis) Dec. 1967 38 p refs
(Contract W-7405-ENG-48)
(UCRL-17896) CFSTI: HC$3.00/MF$0.65

The use of the r-f induction coupled plasma generator for the spheroidization of ceramic powders was studied and an attempt was made to optimize several of the design and operating parameters of the equipment. The most important problem to be over-come was the design of a powder injection nozzle which would give a laminar flow pattern so that accurate placement of the powder in the plasma flame could be accomplished. Attempts were made, with varying degrees of success, to spheroidize SiO_2, NiO, and α-Al_2O_3. Author (NSA)

N68-24613*# Curtiss-Wright Corp., Buffalo, N. Y. Metals Processing Facility.
DEVELOPMENT OF PROCEDURES FOR PRODUCING DISPERSION-STRENGTHENED COBALT BASE ALLOYS BY THE FLASH DRYING SELECTIVE REDUCTION PROCESS
Bernard H. Triffleman 21 Dec. 1967 134 p refs
(Contract NAS3-7272)
(NASA-CR-54516) CFSTI: HC$3.00/MF$0.65 CSCL 13H

Alloy powders having a nominal composition of Co-20Cr-10Ni-15W and containing additions of thoria and lanthana were prepared and evaluated. Procedures were developed for consolidating these powders into 100 per cent dense rod by pressing, sintering, and extruding. In the extruded rod, average dispersoid sizes of the thoria containing alloys varied from 0.12 to 0.41 microns, and average dispersoid sizes of the lanthana containing alloys varied from 0.28 to 0.77 microns. Average interparticle distances varied from 0.56 to 7.04 microns for the thoria alloys and from 5.6 to 13.5 for the lanthana alloys. The dispersed phase volume per cent varied from 3.1-16.1% for the 4 and 5% thoria alloys and was 4.5% for the 4% lanthana alloy. An additional alloy powder having a nominal composition of Co-20Cr-20Ni-4 Vol.% ThO_2 was prepared by similar procedures and evaluated. Average particle sizes of the dispersoid varied from 0.16 to 0.31 microns; interparticle sizes varied from 1.12 to 1.31 microns, and the volume per cent from 8.5 to 13.8%. Author

N68-24619 Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
ULTRASONIC INSPECTION OF WELDS IN SUPPLEMENTARY RINGS IN GRAMINHA'S CESP DUCTS [INSPECRO ULTRA-SONIC NAS TUBULACOES EXISTENTES NOS DUTOS NA USINA DE GRAMINHACESP]
L. X. Nepomuceno, J. R. R. Barreto and G. Mendonca Filho 11 Aug. 1967 13 p refs In PORTUGUESE; ENGLISH summary
(Rept.-6708.294)

The report describes the method, procedure, equipment, and accessories used in the ultrasonic inspection of steel sheet butt weldments. The results are presented in drawing form along with some echograms of typical faults. The welded zones showed defects normally classified as porosity, inclusions, incrustations or lack of adhesion. R.N.A.

N68-24686 Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
STUDY ON THE FEASIBILITY OF ULTRASONIC CLEANING OF SMALL MACHINED INSTRUMENT PARTS [VERIFICACAO DA VIABILIDADE DA LIMPEZA ULTRASONICA DE PEQUENAS PECAS USINADAS EM LATAO]
Z Unglert 24 Nov. 1967 8 p In PORTUGUESE; ENGLISH summary
(Rept.-6711.309)

A number of as-received small machined instrument parts are described along with an analysis of the dirt and soil adhered to their surfaces, the ultrasonic procedure adopted for their cleaning, and the results of this process. The results are presented in terms of the power per unit volume, the frequency used, the solvents studied, and the best results obtained. Also included are photographs of the parts before and after cleaning. Transl. by R.N.A.

N68-24705# Technische Hogeschool, Eindhoven (Netherlands).
THE DEVELOPMENT OF A HYDRAULIC EXCITER FOR THE INVESTIGATION OF MACHINE TOOLS
Antonius Cornelis Hermanus van der Wolf (Ph.D. Thesis) 22 Mar. 1968 94 p refs
CFSTI: HC $3.00/MF $0.65

In order to determine the dynamic qualities of a machine tool, experimental efforts centered on developing an exciter with the capability of introducing both a harmonic force variation and a static force into the element, and of adjusting the frequency of the dynamic force. The properties of the hydraulic high pressure system are explained on the basis of pump and valve equations, and the assumption of oil incompressibility. A model was designed in which the behavior of the hydraulic system is mainly determined by the oil-filled pipes connecting the several elements. The characteristics of the pump and valve are considered boundary conditions of the problem as is the motion of the exciter piston. Two analog models of the hydraulic plant were examined to determine the relationship between pressure amplitude and frequency. A control system for the exciter force is proposed, and a Nyquist diagram of a machine tool is depicted and described. The findings indicate that, despite the restrictions imposed by the hydraulic system, it is possible to generate exciter forces that are of the same order of magnitude as the cutting forces of medium-type machine tools. M.G.J.

N68-24771*# Aeronutronic, Newport Beach, Calif. Space and Re-Entry Systems Div.
DEVELOPMENT OF ADVANCED SOIL SAMPLER TECHNOLOGY Quarterly Progress Report, 1 Jan.–31 Mar. 1968
W. H. Bachle 10 Apr. 1968 70 p Prepared for JPL
(Contracts NAS7-100; JPL-951935)
(NASA-CR-94767; UG-4354) CFSTI: HC $3.00/MF $0.65 CSCL 13C

As a basis for generating engineering prototypes of lunar planetary soil samplers and mechanical sample processors, design criteria are defined for the uncased rotary impact drill sampler (E-1), cased rotary impact drill sampler (E-2), deep abrading cone sieve (E-3), helical conveyor simple particulate sampler (E-4), backhoe sampler (E-5), soil auger sampler (E-6), miniature rotary crusher (E-7), and sample particle size sorter (E-8). The approaches to the partially completed designs are discussed, with particular consideration given to the impact hammer and rotary drive mechanism of E-1; pneumatic transport methods for E-3; the flexibility of the helical conveyor shaft in E-4; the scoop configuration, furlable boom, and mechanically extendible telescoping boom for E-5; mechanized rotation of E-6; differential screw drive and toggle mechanisms for E-7; and batch processing and continuous flow processing concepts for the particle size sorter. M.G.J.

N68-24823 Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
ULTRASONIC THICKNESS MEASUREMENT IN INDUSTRIAL CHEMICAL INSTALLATION TUBING [CONTROLE DA ESPESSURA DE TUBULACAO DE INCONEL EM INSTALACAO DE QUIMICA INDUSTRIAL]
L. X. Nepomuceno, M. F. Barbosa, and I. Rizzardi 1 Sep. 1967 15 p In PORTUGUESE; ENGLISH summary
(TN-6708.299)

The equipment accessories and methods used in the ultrasonic inspection and measurement of wall thickness in a series of Inconel tubes are described. The measurements were conducted to control corrosion in the tubes. Author

N68-25042*# Mechanical Technology, Inc., Latham, N. Y. Pratt and Whitney Aircraft, East Hartford, Conn.
RESEARCH AND DEVELOPMENT OF HIGH PERFORMANCE AXIAL-FLOW TURBOMACHINERY. VOLUME 2: DESIGN OF GAS BEARINGS
P. W. Curwen Washington NASA May 1968 332 p refs Prepared for Pratt and Whitney Aircraft
(Contract NAS3-4179)
(NASA-CR-801) CFSTI: HC $3.00/MF $0.65 CSCL 13I

Three variations of a basic gas-bearing rotor-support system have been designed, built, and tested for the NASA Brayton cycle axial-flow turbocompressor. The designs were experimentally evaluated in a full-scale rotor-bearing system test rig. All three bearing system designs performed satisfactorily and successfully passed the required acceptance tests. The final design represents a minimum bearing-friction-loss design consistent with whirl-free operation of the rotor. Following acceptance testing of the initial gas-bearing rotor-support system, an attempt was made to attain a 61% reduction in total journal bearing friction loss by modifying the bearings to operate at larger clearances. Upon test of the modified design, a low-frequency, stable rotor-whirl phenomenon was observed in the turbine bearing as the clearance was being increased to the larger value. Until the whirl phenomenon is better understood, it is recommended that the diametral clearances of the journal bearings be maintained at $\leq$0.00135 inches. This will assure whirl-free operation of the rotor. At these clearances, the final design represents a 34.3% reduction in total journal bearing friction loss relative to the initial design. Author

N68-25101*# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
BONDING LARGE AREA SILICON WAFERS
[1968] 26 p Prepared for JPL
(Contracts NAS7-100; JPL-952022)
(NASA-CR-94769; QR-3) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Results obtained on the initial studies on the use of low temperature diffusion bonding techniques for the bonding of large and area silicon substrates to heat sinks are described. Liquid–solid and solid–solid diffusion bonding systems are described. Both homo- and hetero-type bonds are possible with each diffusion system. Two-inch diameter silicon wafers have been bonded to molybdenum utilizing a gold–indium liquid–solid diffusion technique. Also silver–gold solid–solid diffusion bonds have been successfully made. The development of a computer program for stress analysis is nearing completion. An analytical solution based upon

superposition techniques has been developed during this period to enable this analysis. An attempt to bond 0.62-inch diameter silicon wafers to tungsten utilizing a molten solder technique based upon aluminum–silicon eutectic solder failed due to rupture of either the solder bond or the silicon body. The thermal conductivities of eutectic aluminum–silicon and tin–lead alloys have been determined.
Author

N68-25107*# Stanford Research Inst., Menlo Park, Calif.
POST TEST ANALYSIS OF GENERANT TANK, PART NO. 9116270-H
R. F. Muraca, A. E. Bayce, C. H. Martin, and J. S. Whittick 15 Apr. 1968 38 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951581; SRI Proj. ASD-6063)
(NASA-CR-94765; SRI-951581-7) CFSTI: HC $3.00/MF $0.65 CSCL 13H

A post-test analysis has been made of the prototype spacecraft generant tank, which had been subjected to intermittent testing with hydrazine and gaseous nitrogen at internal pressures up to 1500 psi and temperatures of less than 150°F. The analysis of the titanium hemisphere, including mechanical property determinations and metallographic examination revealed that no deterioration of properties had occurred during test and that the fabrication was sound. The analysis of the ethylene–propylene expulsion diaphragm indicated that some embrittlement of the elastomer had occurred, accompanied by an apparent loss in tensile strength. The rate of permeation to hydrazine, however, was not significantly different from an equivalent manufacturer's sample.
Author

N68-25139# California Univ., Livermore. Lawrence Radiation Lab.
ON THE METALLURGY OF ELECTRON-BEAM MELTING. PART 2: VOLATILIZATION PROCESSES IN THE 200-KW MULTICHAMBER ELECTRON-BEAM FURNACE
Gerhardt Scharf, Fred Esser, and Dieter Rumberg Nov. 1966 34 p refs Transl. into ENGLISH from Neue Huette (Berlin), v. 11, no. 1, 1966 p 19–27
(UCRL-TRANS-10220, Pt. 2) CFSTI: HC $3.00/MF $0.65

The metallurgical potentialities of melting steel in an electron beam furnace are discussed. Topics covered include the melting process, kinetics of volatilization, volatilization behavior of Cr and Mn alloying elements as a function of specific energy consumption, k values for volatilization of Cr and Mn under remelting conditions, and the effect of programmed beam guidance on temperature distribution and volatilization. It was determined that programmed beam guidance during melting can lead to elimination of quasi-stationary temperature fields and that the method offers greater metallurgical flexibility than other vacuum melting processes.
NSA

N68-25334# Bolkow Entwicklungen K. G., Munich (West Germany).
PROBLEMS AND METHODS OF RELIABILITY WORK [PROBLEME UND METHODEN DER ZUVERLAESSIGKEIT-SARBEIT]
R. Keller 15 Sep. 1966 11 p refs In GERMAN Presented at WGLR/DGRR Ann. Meeting, Bad Godesberg, West Germany, Oct. 1966
(ZV-9-O)

The development, principles, and concepts of reliability engineering in the aerospace industry are reviewed, and the methodology of application is outlined. Briefly discussed are model tests, input data, failure rates of structural components, continuity of production, environmental simulation, quality control, acceptability, error analyses, production engineering measures, and costs.
Transl. by K.W.

N68-25343*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INTERACTIONS BETWEEN A PNEUMATIC TIRE AND A PAVEMENT SURFACE
Walter B. Horne [1968] 25 p ref Presented at the Bur. of Publ. Roads Program Rev. Meeting, Gaithersburg, Md., 6–8 Dec. 1966
(NASA-TM-X-61108) CFSTI: HC $3.00/MF $0.65 CSCL 13F

The Supersonic Transport and your family car have one common feature: the pneumatic tire. Both of these widely differing vehicles depend upon the pneumatic tire to perform three basic functions for safe and reliable ground operation. These functions are: (1) To support the mass of the vehicle and its payload under all static and rolling conditions, (2) To develop cornering or side forces for vehicle steering and to oppose external side forces acting on a vehicle such as from crosswinds, centrifugal effects in curves or turns, and gravitational components due to pavement crowns, (3) To develop propulsive forces from driving wheels to maintain vehicle motion and to develop retarding forces from braking wheels to arrest vehicle motion. How well the pneumatic tire performs these three functions for the vehicle depends on the condition of the pavement. The interactions between tire and ground, and therefore vehicle safety, vary greatly with both tire and pavement conditions. It is the purpose of this paper to briefly describe the nature of some of these major tire-pavement interactions.
Author

N68-25364*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FACTORS AFFECTING THE QUALITY AND RELIABILITY OF PRODUCTS
A. V. Glichev Redstone Arsenal, Ala. Redstone Sci. Inform. Center 4 Apr. 1968 13 p Transl. into ENGLISH from Standarty i Kachestvo (USSR), no. 6, 1966 p 69–71 Sponsored jointly by Army
(NASA-TM-X-61105; RSIC-775) CFSTI: HC $3.00/MF $0.65 CSCL 14D

A general discussion of factors affecting the quality and reliability of products classifies these factors according to technical, organizational, and price. Application of progressive technological processes and more know-how in the planning and design stages are considered among the more important factors. The three types of factors are then related to the planning, production, and operation of a product; and the role of the human operator is mentioned.
M.W.R.

N68-25416*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CONVECTIVE INERTIA AND GAS INGESTION EFFECTS ON FLOW REGIMES OF THE VISCOSEAL THEORY AND EXPERIMENT
John Zuk, T. N. Strom, L. P. Ludwig, and R. L. Johnson 1967 63 p refs Presented at ASLE Ann. Meeting, Toronto, 1–4 May 1967
(NASA-TM-X-52283) CSCL 13K

An experimental and visual investigation of the viscoseal operating regions was conducted. A mathematical model was formulated for the homogeneous fluid region which resulted in an evolution of a modified Reynolds number based on two characteristic lengths. Importance of convective inertia forces and changes in the functional relations between variables in the superlaminar flow regime are discussed. Correlation between modified Reynolds number and sealing capacity improvement is found. Experimental studies using oil, water, and liquid sodium were conducted on pressure patterns, end effect, gas ingestion, and sealing capacity. Studies reveal a fundamental difference in the gas ingestion mechanism between grooves on the shaft and grooves on the housing. Gas ingestion could be eliminated in the grooved housing operational mode. Secondary grooves on the viscoseal land areas improved sealing capacity. Sodium was sealed at 300° to 625°F with negligible liquid loss.
Author

N68-25445# California Univ., Livermore. Lawrence Radiation Lab.
ON THE METALLURGY OF ELECTRON BEAM MELTING. PART 1: MEASUREMENT OF STEEL BATH TEMPERATURE WITH AN OBJECTIVE COLOR PYROMETER
Fred Esser, Gerhard Scharf, and Dieter Rumberg Dec. 1966 21 p refs Transl. into ENGLISH from Neue Huette (Germany), v. 10, 1965 p 333–338
(UCRL-TRANS-10215) CFSTI: HC $3.00/MF $0.65

Techniques and equipment developed to measure the temperature of molten steel surfaces in a multichamber electron-beam furnace, by use of a color pyrometer, are described. Aspects considered are radiation intensity, emission factors, spectral transmission of observation windows, condensation on windows, measurement circuits, results and evaluation of experimental measurements. NSA

N68-25456# California Univ., Livermore. Lawrence Radiation Lab.
ACOUSTIC EMISSION: A NEW NONDESTRUCTIVE TESTING TOOL
H. Dunegan and D. Harris 16 Jan. 1968 37 p refs Presented at the 3d Ann. Symp. on Nondestructive Testing of Welds and Mater. Joining, Los Angeles, 12 Mar. 1968
(Contract W-7405-ENG-48)
(UCRL-70750; CONF-680304-1) CFSTI: HC $3.00/MF $0.65

A new approach to nondestructive testing is proposed which is centered around the concept of utilizing transducer action of a flaw in a stress field. This situation results in localized plastic deformation occurring in the vicinity of the flaw which in turn gives up energy in several ways. Thermal emission, exo-electron emission and acoustic emission are the three primary forms that this energy takes upon release. The first two are mentioned briefly and acoustic emission is reported in detail. Acoustic emission from unflawed tensile specimens can be treated from a dislocation dynamics approach. A very good correlation between the acoustic emission and a proposed theoretical model for mobile dislocation density as a function of plastic strain is shown for aluminum. A theoretical model for the plastic volume around a sharp crack in an elastic stress field previously developed, predicted that the summation of acoustic emission should vary as the fourth power of the stress intensity factor at the crack tip. Experimental data from 7075-T6 aluminum are shown that agrees well with this model. It is further shown that acoustic emission data from flawed specimens, interpreted from a fracture mechanics viewpoint, can find direct applications for nondestructive quality assurance tests on engineering structures. Author (NSA)

N68-25471*# Tennessee Univ., Knoxville.
THE TURBULENT VISCO SEAL: THEORY AND EXPERIMENT
William K. Stair and Robert H. Hale (General Electric Co., Daytona Beach, Fla.) Apr. 1967 16 p refs Presented at the 3d Intern. Conf. on Fluid Sealing, Cambridge, Eng., Apr. 1967 Conf Paper H2
(Grant NsG-587)
(NASA-CR-83498) CFSTI: HC $3.00/MF $0.65 CSCL 13K

Experimental evaluation of the laminar visco seal for a number of seal geometries has shown that the analysis of Boon and Tal is in better agreement with experiment than any other analytical approach. The sealing performance improved and became dependent upon Reynolds number as turbulent conditions were encountered. A theoretical equation was derived for the sealing coefficient of a visco seal suitable for both laminar and turbulent operation. A procedure was devised in which the ordinary pipe friction data could be utilized to evaluate the empirical factors in the turbulent sealing coefficient equation. Thus the performance of the turbulent visco seal can be estimated before construction. Experimental tests with 10 different seals confirmed the utility of both the theoretical analysis and the method of approximation of the experimental constants. Author

N68-25511# Lord Mfg. Co., Erie, Pa.
THE SHIM SPRING ISOLATOR
Leon Wallerstein, Jr. *In* NRL The Shock and Vibration Bull. Jan. 1968 p 163–173 refs (See N68-25498 14-32)

Described is a new spring form designated shim spring which stores from three to nine times more energy per pound or per cubic inch than conventional metallic springs operating at the same stress. The spring requires no external damper and will operate continuously to at least 500°F. Externally, the shim spring resembles a metallic block having the unusual property that it will deflect readily in shear. It is made of thin, high strength alloy shims arranged so that every element is in direct tension or direct compression. Discussed are advantages and disadvantages of the basic spring design, and its applications in aircraft turbine tests. S.C.W.

N68-25523*# Boeing Co., Seattle, Wash. Launch Systems Branch.
INVESTIGATION OF ELECTRON BEAM WELDS IN A SENSOR TUBE
Terry Ceasar 1 Mar. 1968 15 p refs
(Contract NAS8-5608)
(NASA-CR-61812; T5-6539-102) CFSTI: HC $3.00/MF $0.65 CSCL 13H

An evaluation is presented on the weld quality of an electron beam welded sensor tube intended for use in constructing a LOX engine cutoff sensor. Based on visual and X-ray examination, hardness tests, and microscopic analysis, it was determined that the electron beam welds were of excellent quality and that their use in the sensor assembly would prove satisfactory. Author

N68-25597# Lockheed Missiles and Space Co., Palo Alto, Calif.
APPARATUS FOR THE INVESTIGATION OF SHOCKWAVES
A. I. Lopatin and V. G. Kas'ian 1967 4 p Transl. into ENGLISH from Samoletostr. i Tekhn. Vozdush. Flota (Kharkov), no. 9, 1967 p 94–97

To investigate shock wave parameters by a shadow method, an apparatus was produced that consisted of a shadowgraph working in conjunction with a high speed moving picture camera. An additional optical system was mounted between the entrance pupils of the shadowgraph and camera. Because of the small diameter of the working field and the low admissible charging weight, this apparatus permits the study of explosive stamping and electrohydraulic stamping only on the model equipment. An exploding wire was used to initiate the explosive in the experiments, and this affords the possibility of time synchronization at the beginning of the development with the beginning of the photographing. The circuit is shown that permits ignition of the pulsed light source and initiation of the investigated phenomenon at the time the high voltage pulse shaped in the control unit of the camera is presented to its input. A moving picture of the shock impacting on a conical rod and produced by a wire exploding in air is shown, as is a picture of shock wave interaction with a thin metal membrane produced by a 500 mg explosion in air at 400 mm from the membrane. M.W.R.

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N68-24511*# Electro-Optical Systems, Inc., Pasadena, Calif.
FEASIBILITY STUDY OF A NONCONTACTING, REMOTE SENSING DISPLACEMENT TRANSDUCER Final Report, 17 Apr. 1967–12 Jan. 1968
18 Mar. 1968 218 p refs
(Contract NAS5-10345)
(NASA-CR-94677; EOS-7205-Final) CFSTI: HC $3.00/MF $0.65 CSCL 20E

This report presents the results of a feasibility-design study of a laser-based displacement transducer. The work included a preliminary verification of the suitability of the laser approach, a systems analysis and design, and layouts of the electrical, optical, and mechanical design. It was concluded that the layout design is capable of remotely measuring displacements with a resolution on the order of 10^{-9} inch. It is recommended that a prototype transducer be constructed and tested. Author

N68-24520# Bureau of Mines, Albany, Oreg. Metallurgy Research Center.
DEVELOPMENT OF A HIGH TEMPERATURE INTERFEROMETRIC DILATOMETER USING A LASER LIGHT SOURCE
P. M. Johnson, R. L. Lincoln, and E. R. McClure Jun. 1968 15 p refs
(BM-RI-7142)

A design for a laser-powered optical interferometer, using a specimen whose thermal expansion is to be measured as part of the optical system, was conceived and applied in a prototype dilatometer. The object of this work was the development of an absolute dilatometer capable of use at elevated temperatures, particularly above 1,000°C. The prototype was operated at temperatures exceeding 1,500°C. Results obtained with this device agree within 2.5 percent with the published data for the coefficient of expansion of columbium. Author

N68-24581# Defence Standards Labs., Maribyrnong (Australia).
SOME RECENT DEVELOPMENTS IN LASERS REPORT ON OVERSEAS VISIT JULY/AUGUST 1967
W. E. K. Gibbs Mar. 1968 20 p refs
(Rept.-306) CFSTI: HC $3.00/MF $0.65

Developments in laser applications, mode-locked lasers, liquid lasers, saturable absorbers, and laser measurements are discussed. The relevance of this work to the program of basic research in the D.S.L. Laser Group is assessed and recommendations about the future program are made. These involve a concentration of effort on the carbon dioxide laser and the related effects of high power laser radiation on materials. Author

N68-25415# Weapons Research Establishment, Salisbury (Australia).
NORMALIZED OUTPUT POWER AND GAIN MEASUREMENTS FOR THE ARGON ION LASER
B. A. See Dec. 1967 42 p refs
(WRE-TN-PAD-129) CFSTI: HC $3.00/MF $0.65

The specific output power at 4880 Å and 5145 Å and gain for 4880 Å and 5145 Å lines are presented in normalized curves as a function of input power. The relative power input with and without applied field is given, which allows the output and gain for any tube to be predicted at these wavelengths. The 4880 Å line has been observed to saturate uniformly over the oscillation bandwidth, while the 5145 Å line saturates locally at the resonant frequency. Estimates of the relevant saturation parameters are given. Author

N68-25562*# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Systems.
PORTABLE LASER INSTRUMENT FOR VIBRATION ANALYSIS AND TRANSDUCER CALIBRATION
G. A. Massey and R. R. Carter *In* NRL The Shock and Vibration Bull., No. 37, Pt. 2 Jan. 1968 p 1–6 (See N68-25561 14-32)
(Contracts NAS2-3137; NAS2-3643; NAS2-4176)

The design and performance of a laser heterodyne system providing sensitive broadband measurement of vibrations of mechanical structures and electromechanical transducers are described. A single-frequency laser is used as the source, and a liquid acoustic-diffraction cell is used to shift the frequency of the reference or "local oscillator" beam in an interferometer. A second unshifted beam is reflected from the vibrating surface. When the reflected and shifted beams are combined on a photodetector, a beat frequency at 25 MHz is produced. Periodic motion of the reflecting surface then produces modulation sidebands about the 25-MHz difference or intermediate frequency. Equal phase shifts on the reflected light and on the intermediate frequency are produced by the motion. Thus the amplitude and frequency of the vibration can be recovered by demodulation of the phase-modulated 25-MHz signal, or by direct measurement using an ordinary radio-frequency spectrum analyzer. The 25-MHz frequency offset removes the directional ambiguity of the Doppler shift usually found in interferometer devices of this type. The single-frequency laser allows the working distance to be adjusted over a 5-in. range, with a nominal working distance of 4 ft between the surface and the instrument. Measurements of vibration amplitudes from 0.25 in. to less than 0.04 in. and frequencies from 10 Hz to 700 kHz have been made with the prototype instrument in the laboratory. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N68-24397# Advisory Group for Aerospace Research and Development, Paris (France).
STRESS CORROSION CRACKING IN AIRCRAFT STRUCTURAL MATERIALS
H. G. Cole, ed. 1967 251 p refs Presented at the AGARD Structures and Materials Panel Symp., Turin, 18–19 Apr. 1967
(AGARD-CP-18) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. GENERAL THEORY OF STRESS CORROSION M. G. Fontana (Ohio State Univ.) 21 p refs (See N68-24398 14-17)
2. LABORATORY ASPECTS OF ALUMINUM ALLOYS H. Cordier (Vereinigte Leichtmetall-werke G.m.b.H.) 13 p refs (See N68-24399 14-17)
3. SOME ENGINEERING ASPECTS OF STRESS CORROSION CRACKING IN HIGH STRENGTH ALUMINUM ALLOYS J. J. Waller (Canadair, Ltd.) 14 p (See N68-24400 14-17)
4. ENGINEERING ASPECTS OF STRESS CORROSION FAILURE IN MARTENSITIC STEELS E. A. Steigerwald (TRW Equip. Labs.) 44 p refs (See N68-24401 14-17)
5. STRESS CORROSION CRACKING OF HIGH STRENGTH STAINLESS STEELS E. E. Denhard, Jr. (Armco Steel Corp.) 38 p refs (See N68-24402 14-17)
6. STRESS CORROSION OF TITANIUM ALLOYS J. B. Cotton (Imperial Metal Industries) 23 p refs (See N68-24403 14-17)
7. STRESS CORROSION CRACKING OF VERY STRONG LOW-ALLOY AND MARAGING STEELS: LABORATORY ASPECTS L. Matteoli and T. Songa (Istituto di Richerche Breda S.p.A.) 65 p refs (See N68-24404 14-17)
8. NATIONAL SURVEYS OF WORK ON STRESS CORROSION CRACKING 23 p (See N68-24405 14-17)

N68-24398# Ohio State Univ., Columbus. Dept. of Metallurgical Engineering.
GENERAL THEORY OF STRESS CORROSION
Mars. G. Fontana *In* AGARD Stress Corrosion Cracking in Aircraft Structural Mater. 1967 21 p refs (See N68-24397 14-17)

Stress corrosion is defined as the premature cracking of alloys characterized by brittle fracture, localized corrosion, and specificity of the alloy-environment system. A distinction is made between stress corrosion and hydrogen embrittlement, and a figure is given to illustrate schematic differentiation between the two modes of cracking. Conditions for stress corrosion are summarized with respect to crack morphology, strengthening mechanisms, metallurgical factors, composition, and environments. It is pointed out that not all environments cause cracking and not all alloys are susceptible to cracking in a given environment. Possible theories, mechanisms, and operating steps are presented for consideration in the stress corrosion problem. B.S.D.

N68-24399# Vereinigte Leichtmetall-Werke G.m.b.H., Bonn (West Germany). Leichtmetall Forschungs Institut.
LABORATORY ASPECTS OF ALUMINUM ALLOYS
Hildegard Cordier *In* AGARD Stress Corrosion Cracking in Aircraft Structural Mater. 1967 13 p refs (See N68-24397 14-17)

Various opinions are presented on the processes contributing to the stress corrosion cracking of AlZnMg and AlZnMgCu-alloys. Laboratory methods of testing for stress corrosion cracking are discussed, and a relationship is given for determining percentage proportion of the stress corrosion. A number of conceptions about the mechanisms of stress corrosion cracking in aluminum alloys are given, and the metallurgical measures to avoid it are described. B.S.D.

N68-24400# Canadair, Ltd., Montreal (Quebec).
SOME ENGINEERING ASPECTS OF STRESS CORROSION CRACKING IN HIGH STRENGTH ALUMINUM ALLOYS
J. J. Waller *In* AGARD Stress Corrosion Cracking in Aircraft Structural Mater. 1967 14 p (See N68-24397 14-17)

An attempt is made to present some of the problems and solutions of stress corrosion cracking which confront the design engineer when designing structural parts made of high strength aluminum alloys. Some of the factors associated with the manufacturing and assembly of such parts that can lead to service failures due to stress corrosion cracking are discussed. The problems and decisions to be considered in the normal sequence of events, from the basic conception of a forging design to a completely assembled unit of a major airframe component, are described. B.S.D.

N68-24401# TRW Equipment Labs., Cleveland, Ohio. Materials Research and Development Dept.
ENGINEERING ASPECTS OF STRESS CORROSION FAILURE IN MARTENSITIC STEELS
E. A. Steigerwald *In* AGARD Stress Corrosion Cracking in Aircraft Structural Mater. 1967 44 p refs (See N68-24397 14-17)

The engineering aspects of stress corrosion failures in steels are discussed with particular emphasis on the delayed failures which occur in high-strength steels exposed to water-containing environments. Considering a variety of laboratory methods for evaluating stress corrosion behavior in high-strength materials, the use of pre-cracked specimens represents the most effective test technique. The presence of the pre-crack decreases the failure time and provides optimum sensitivity and reproducibility. In addition, linear elastic fracture mechanics methods can be applied to analyze the failure data and provide a quantitative indication of expected failure characteristics in actual components. In a given class of steels, the susceptibility of stress corrosion as measured by time to failure, can be correlated with the basic fracture toughness of the material. This results from the fact that the stress corrosion crack has to grow a longer distance in a tougher steel before fracture occurs. Author

N68-24402# Armco Steel Corp., Baltimore, Md. Research and Technology.
STRESS CORROSION CRACKING OF HIGH STRENGTH STAINLESS STEELS
E. E. Denhard, Jr. *In* AGARD Stress Corrosion Cracking in Aircraft Structural Mater. 1967 38 p refs (See N68-24397 14-17)

A review of the stress corrosion characteristics of high strength stainless steels with particular emphasis on aircraft applications is presented. An attempt was made to correlate laboratory test results with natural exposure and service behavior and, where possible, to suggest maximum stress levels for design considerations. The steels covered include the cold worked austenitic, the martensitic and the precipitation hardening types. Some typical aircraft applications of each are described. The mechanism of failure in the light of current theories is discussed including the metallurgical development of alloys for stress corrosion resistance. Protective measures and their effectiveness are reviewed. Author

N68-24403# Imperial Metal Industries (Kynoch), Ltd., Birmingham (England). Research Dept.
STRESS CORROSION OF TITANIUM ALLOYS
J. B. Cotton *In* AGARD Stress Corrosion Cracking in Aircraft Structural Mater. 1967 23 p refs (See N68-24397 14-17)

The stress corrosion of titanium alloys in halide environments is summarized with particular reference to the corrosion process in hot unstabilized chlorinated hydrocarbons, hot dry sodium chloride, and aqueous saline solution at ambient temperature. The prevention of cracking in a range of chlorinated hydrocarbons by the addition of suitable stabilizers and inhibitors to the degreasants is described, and conditions leading to the use of safe degreasing systems are defined. Details are given on the laboratory investigations and tests conducted on the effect of hot-salt stress corrosion on titanium alloys, and the metallurgy and chemistry involved in hot salt stress cracking is discussed along with possible protective measures. Stress corrosion cracking of titanium alloys in salt water is discussed in relation to laboratory conditions imposed by pre-fatigue cracking followed by cantilever stressing of the crack region. Features common to cracking in all three environments are collated and discussed with respect to fundamental aspects of stress corrosion and of the direction in which remedies may be sought. B.S.D.

N68-24404# Instituto di Ricerche Breda S.p.A., Milan (Italy).
STRESS CORROSION CRACKING OF VERY STRONG LOW-ALLOY AND MARAGING STEELS: LABORATORY ASPECTS
Leno Matteoli and Tullio Songa *In* AGARD Stress Corrosion Cracking in Aircraft Structural Mater. 1967 65 p refs (See N68-24397 14-17)

The mechanical and metallographic properties are given for the three main groups of steels—heat treatable low tempered CrNiMo steels and similar kinds, chromium steels, and maraging steels. The mechanisms and characteristics of hydrogen embrittlement are discussed, and a polarization method of distinguishing between hydrogen embrittlement and stress corrosion cracking is presented. The stress corrosion of low alloy steels and maraging steels is examined in relation to corrosive environments, crack formation and crack type, structure, and heat treatment processes. The effect of the chemical composition of maraging steels on the resistance to delayed fracture is also studied. B.S.D.

N68-24405# Advisory Group for Aerospace Research and Development, Paris (France).
NATIONAL SURVEYS OF WORK ON STRESS CORROSION CRACKING

In its Stress Corrosion Cracking in Aircraft Structural Mater. 1967 23 p (See N68-24397 14-17)

A national survey was conducted on the current research and development work on stress corrosion cracking of aluminum alloys, steels, and titanium alloys. Reports are included from Canada, France, Germany, Italy, Norway, United Kingdom, and the United States. The results of this survey are summarized. B.S.D.

N68-24477*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

YIELDING AND FRACTURE IN TUNGSTEN AND TUNGSTEN-RHENIUM ALLOYS

Peter L. Raffo Washington May 1968 36 p refs

(NASA-TN-D-4567) CFSTI: HC $3.00/MF $0.65 CSCL 11F

A study was made of the mechanical properties of vacuum arc-melted tungsten and tungsten-rhenium alloys in the temperature range 77° to 810°K in order to elucidate the mechanism by which rhenium additions lower the ductile-brittle transition temperature of tungsten. The temperature and strain-rate dependence of the yield stress of tungsten is reduced by alloying with rhenium. This is shown to be because of a reduction in the Peierls stress. The reduction in the transition temperature is attributed to the reduced Peierls stress through its effect on the mobility and rate of multiplication of dislocations. Author

N68-24490# Instituto de Energia Atomica, Sao Paulo (Brazil).

UTILIZATION OF THE IBM 1620 COMPUTER FOR ESTIMATING THE MATERIAL CURVATURE OF MULTIPLE COMPOSITIONS [UTILIZACAO DO COMPUTADOR IBM 1620 PARA ESTIMATIVAS DA CURVATURA MATERIAL DE ARRANJOS MULTIPLICADORES]

H. R. Franzen and Elenice Mazzilli Nov. 1966 33 p refs In PORTUGUESE

(IEA-128) CFSTI: HC $3.00/MF $0.65

The Frama program was developed for the IBM 1620 to evaluate the material bucklings of uranium oxide moderated by D_2O/H_2O mixtures. Material buckling values are given for 15 uranium oxide lattices slightly enriched in U^{235} incased in 304 stainless steel. The D_2O/H_2O concentrations were 99.4, 81.0, and 55.0%. All the results obtained were considered satisfactory within the objectives of this work. Also included are a listing of the Fortran program, a flow chart, and a numerical example. Author

N68-24505# General Electric Co., Schenectady, N. Y. Research and Development Center.

INTERGRANULAR CORROSION AND ELECTRON MICROSCOPIC STUDIES OF AUSTENITIC STAINLESS STEELS

K. T. Aust, J. S. Armijo, E. F. Koch, and J. H. Westbrook May 1967 24 p refs

(Rept.-67-C-164)

The corrosion behavior of types 304, 304L, and 302 austenitic stainless steel in nitric-dichromate solution was studied as a function of heat treatment. Electron microscopy, microhardness tests, and transmission electron microscopic examination of corroded thin films of material subjected to different heat treatments yield results that provide strong support for a proposed model of intergranular corrosion. In this model, the corrosion behavior is associated with the presence of continuous grain boundary paths of either second phase or solute-segregated regions. On the basis of this model, it is demonstrated that the intergranular corrosion susceptibility of these austenitic stainless steels may be substantially reduced by suitable heat treatments. Author

N68-24542# Bureau of Mines, Albany, Oreg. Metallurgy Research Center.

CAST HAFNIUM CARBIDE-CARBON ALLOYS: PREPARATION, EVALUATION, AND PROPERTIES

Robert P. Adams, M. I. Copeland, D. K. Deardorff, and R. L. Lincoln Jun. 1968 53 p refs Sponsored jointly by AEC

(BM-RI-7137)

Because of the extreme interest in materials with high melting temperatures and the advantages offered over the power route for making high-density material, arc melting and centrifugal casting methods were investigated for preparing shapes of hafnium carbide with and without excess carbon. Highly satisfactory equipment was constructed and efficient operating procedures were established. Also, methods for preparing consumable electrodes and shrink-tolerant graphite molds were developed. Although crack-free hafnium carbide (6.3 weight-percent carbon) shapes were not made, coherent castings containing 9 to 13.5 weight-percent carbon were produced; the same compositions were shown to be resistant to thermal shock. Author

N68-24558*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ELECTRICAL AND MECHANICAL PROPERTIES OF A SUPERIOR HIGH-TEMPERATURE COBALT–IRON MAGNETIC MATERIAL

John P. Barranger Washington May 1968 22 p refs

(NASA-TN-D-4551) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The alternating current electrical and mechanical properties of high purity alloys of 9 weight percent iron, the balance being mostly cobalt, were determined at temperatures from 25° to 1000°C. Data are presented for four thicknesses from 0.002 inch (0.005 cm) to 0.012 inch (0.030 cm) and at six frequencies from 60 to 3200 hertz. The results of the measurements and comparisons with a commercial alloy indicate that the material is one of the best magnetic materials for high temperature transformer core applications. Author

N68-24627# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.

A PROGRAM OF BASIC RESEARCH ON MECHANICAL PROPERTIES OF REACTOR MATERIALS Final Summary Report, 1 Nov. 1965–12 May 1967

R. H. Chambers, T. E. Firle, T. Trozera, and G. Buzzelli 28 Jul. 1967 191 p refs

(Contract AT(04-3)-167)

(GA-7978) CFSTI: HC $3.00/MF $0.65

Results of various research programs being conducted to determine the mechanical properties of reactor materials are presented. Included among the studies are (1) a method of measuring the plastic properties of relatively brittle metals, (2) thermally activated dislocation relaxations in FCC and BCC transition metals, (3) correlation of strain release measurements with tests of the ductile-to-brittle transition, and (4) a method for dislocation pinning in niobium. An instrument designed for the measurement of gamma relaxation process in BCC transition metals is described, and measurement of internal friction on tantalum by an inverted torsion pendulum is reported. Also included is an investigation of the influence of radiation induced point defects on the mobility of dislocations in the BCC transition metals. B.S.D.

N68-24632 Joint Publications Research Service, Washington, D. C.

INFLUENCE OF CONDITION OF IMPURITIES ON STRAIN ORIENTATION IN LOW-ALLOYED ALPHA URANIUM

V. E. Ivanov, V. F. Zelenskiy, V. V. Kunchenko, N. M. Royenko, V. S. Krasnorutskiy et al 23 May 1968 13 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 24, no. 1, Jan. 1968 p 87–91 Submitted for publication

(JPRS-45470) CFSTI: $3.00

Consideration is given to the structure of deformed alpha-uranium which depends upon the nature of strain and temperature. The dependence of the nature of the strain orientation

upon temperature can be accounted for by the existence of several slip and twinning systems which are realized in various temperature ranges. The influence of impurities on strain orientation in low-alloyed alpha uranium is examined in relation to the slip and twinning systems at various temperatures. Experimental techniques are given along with graphical representation of results. B.S.D.

N68-24669 Cincinnati Univ., Ohio.
COUNTERDIFFUSION OF ALUMINUM AND ARSENIC IN IRON
John H. Meiser (Ph.D. Thesis) 1966 75 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-1972

Etching and visual examination were used to follow the advance of bands from the two interfaces. The leading edge of the band was used to calculate the diffusivity from the equation $x^2 = 4\ Dt$. The diffusivity of aluminum in iron in the presence of arsenic was found to be 1.68×10^{-8} cm^2/sec at 1200°C. For arsenic, the value is 5.90×10^{-9} cm/sec. The advance of a two phase region identified as α and γ in the aluminum-iron phase diagram from the aluminum side is related to the maximum in the rate of change of the flux J with distance, to the maximum in the rate of change of the concentration of diffusing aluminum to which it is numerically equal. The formation of aluminum arsenide is postulated as a possible reason for the decrease in diffusion rates and separated precipitate bands which appear in some samples. Dissert. Abstr.

N68-24674# Illinois Univ., Urbana.
STAGE 3 ANNEALING IN GOLD AFTER ELECTRON IRRADIATION
Choochon Lee Feb. 1968 189 p ref
(Contract AT(11-1)-1198)
(COO-1198-511) CFSTI: HC $3.00/MF $0.65

Gold specimens of nominal 99.9999% purity were irradiated with 3 MeV electrons near liquid nitrogen temperature. The damage production rate is found to depend on the purity of the specimen giving a lower value for the high purity specimens. It is also found that the production rate is reduced remarkably by quenching the specimen before irradiation. For high purity gold, a single large annealing peak is observed in Stage III. The slope change method and Primak analysis are employed to obtain the activation energy of Stage III annealing. Both methods give 0.85 ± 0.02 eV for the activation energy in high purity irradiated specimens. The activation energies for quenched, and quench-plus-irradiated specimens of comparable purity are found to be 0.85 ± 0.03 eV and 0.86 ± 0.02 eV respectively, agreeing with the value for the irradiated specimens within the experimental error. Somewhat lower values are obtained for specimens of lower purity. Second order kinetics are obeyed in the main part of the Stage III annealing for the irradiated, quench-plus-irradiated and quenched specimens. Various models are discussed to explain Stage III annealing. It is concluded that vacancy migration in Stage III with interstitial clusters acting as sinks can account for the observed results most satisfactorily in the case of gold. Author (NSA)

N68-24716# Aerojet-General Corp., San Ramon, Calif. Nuclear Products and Services Group.
EVALUATION STUDY OF HASTELLOY X AS A NUCLEAR CLADDING Quarterly Progress Report, 1 Jul.–30 Sep. 1967
Nov. 1967 50 p refs
(Contract AT(04-3)-368)
(AGN-8246) CFSTI: HC $3.00/MF $0.65

Microconstituents were extracted from specimens of as-received low-cobalt Hastelloy X tubing and commercial-cobalt Hastelloy X sheet material. The X-ray diffraction analyses of the residues identified a high and a low parameter M_6C-type carbide in both materials. A similar evaluation of specimens of commercial-cobalt sheet material which had been aged for 2680 hr in inert gas at 1300°F revealed that both of the M_6C-type carbides exist after aging at relatively low temperature, along with sigma and mu phase. Electron microprobe analyses were performed on samples of low- and commercial-cobalt Hastelloy X tubing which had been exposed in air at 1900 and 2000°F to identify localized changes in the chemical composition of the carbide precipitates, oxide layers and matrix of the alloy. The most significant result was the determination that the Mn-rich outer oxide layer exists on samples aged at temperatures up to 2000°F. The thermogravimetric tests of specimens of four heats of Hastelloy X were terminated by equipment failure after 3400 hr of exposure. The assembly of the apparatus for the performance of tensile creep tests in argon was completed and the system was checked out. Tests of two specimens were initiated but the work was interrupted almost immediately by failure of four cooling water lines. The centrifugal creep testing of specimens from three heats of Hastelloy X at 1300°F in argon was terminated after completion of the scheduled 3000 hr of uninterrupted testing. The data were reduced and analyzed. Comparison of the data showed one heat (low cobalt E-9505) consistently displayed superior strength properties than the other two heats (commercial cobalt X5-4793, X5-4904 vacuum melted). Based upon these data vacuum melting does not appear to significantly affect the creep properties of Hastelloy X. The design of centrifugal creep specimens for testing at 1400°F in argon was completed and fabrication of these test specimens is in progress. NSA

N68-24749# Joint Publications Research Service, Washington, D. C.
MATERIALS SCIENCE AND METALLURGY, NO. 45
11 Mar. 1968 190 p refs
(JPRS-44636)

Publication contains abstracts of articles from USSR scientific and technical journals on subjects covering materials science and metallurgy. Author

N68-24841# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
STUDY OF ELEMENTARY MECHANISM OF CREEP IN U AS A FUNCTION OF TEMPERATURE (150° TO 760°C) BY ACTIVATION ENERGY MEASUREMENTS [ETUDE DES MECANISMES ELEMENTAIRES DE DEFORMATION PAR FLUAGE DE L'URANIUM EN FONCTION DE LA TEMPERATURE (DE 150° A 760°C) PAR LA MESURE DES ENERGIES D'ACTIVATION]
Pierre Grenier (Ph.D. Thesis—Paris Univ.) Nov. 1967 79 p refs In FRENCH
(CEA-R-3187)

Creep tests were carried out on single crystals and polycrystalline specimens of uranium in both the α and β phases at 150 to 760°C. The determination of the activation energy for creep and the study of its variation with temperature made it possible to distinguish various temperature ranges in which one or more elementary mechanisms govern deformation. Micrographic observations after creep and the study of the variation of creep-rate with load support the conclusions. The creep behavior of single crystals is identical with that of polycrystalline material below 325°C. From 325°C to one upper limiting temperature whose value depends on the purity and previous history of the metal, the creep deformation of uranium is controlled by cross-slip. From this limiting temperature up to 520°C, the creep of uranium involves two independent mechanisms operating simultaneously, the movement of screw dislocation by cross-slip and the climbing of edge dislocations out of their slip plane. Between 520°C and the α-β transformation temperature creep in polycrystals is governed by the climb of edge dislocations out of their slip planes, by a pile up mechanism in the case of primary creep and by dipole annihilation in the case of secondary creep. In single crystals creep is dependent

on the climb of edge dislocations into pre-existent subboundaries and their subsequent rearrangement within these boundaries. In the β phase the creep of polycrystals is governed by the diffusional climb of edge dislocations. Between 450° and 630°C small alloy additions of molybdenum modify the creep characteristics of uranium although the deformation mechanisms involved are analogous to those in the pure metal. Author (NSA)

N68-24890# Airesearch Mfg. Co., Los Angeles, Calif.
INVESTIGATION OF MATERIALS TO RESIST HOT CORROSION IN SMALL GAS TURBINE ENGINE RECUPERATORS Quarterly Report, Dec. 1, 1967–Feb. 29, 1968
G. Curbishley, O. Jones, and W. Larson Mar. 1968 60 p
(Contract DAAJ02-67-C-0048)
(HT-67-2512(3); QR-3; AD-667370)

The program has the primary objective to conduct theoretical and experimental investigations of hot corrosion in Type 347 Stainless Steel and three other candidate materials. The initial tasks of the program were to select base metal materials for tubing and brazing alloys for joining. The selection to be based on a theoretical analysis and evaluation of the candidate materials ability to resist hot corrosion at 1500F. The preliminary brazing tests, now complete except for microprobe analysis, consisted of metallographical evaluation of the brazed joints and a 100 hour static hot corrosion test. Materials selected are as follows: Tubing--Hastelloy X, Incoloy 800, Multimet N-155, 347 CRES; Brazing alloy--Palniro 1 and J-8100, Palniro 7 and Coast Metals 508, Palniro 1 and Nicrobraz 200, Palniro 7 and Nicrobraz 135. The cyclic-temperature hot corrosion tests, now in progress, are designed to develop stress rupture data from which two brazed base metal conbinations can be selected for further testing in Phase II of the program. The test procedure and equipment are described and the initial data points are tabulated. Author (TAB)

N68-24902# Bristol Aeroiet. Ltd., Banwell (England).
THE CHEMICAL CONTOURING OF 18 PER CENT NICKEL MARAGING STEEL SHEET
London Min. of Technol. Apr. 1967 27 p refs Prepared jointly with Westland Aircraft, Ltd., Cowes, Engl.
(Contracts KS/1/0276/C.B.43(a)2; KS/1/0270/C.B.43(a)2)
(D-MAT-143) CFSTI: HC $3.00/MF $0.65

A solution has been developed for the chemical contouring of aged 18% nickel maraging steel sheet. The solution contains 20% nitric acid, 5% sulphuric acid and 5% phosphoric acid, by volume of concentrated acids in water, to which 2.7% by weight of sodium heptonate is added. Uniformity of etch depth, edge definition and surface finish are good. A neoprene type resist gave good performance as a maskant. The effect of the process on mechanical properties has been evaluated on material heat treated to a tensile strength of 146 tsi. No effect was found on sustained load properties. Fatigue properties were improved compared with as-received and aged material, probably because rolling laps were removed. Author

N68-24977*# Volt Technical Corp., Washington, D. C.
MATERIALS FOR ASTRONOMICAL MIRRORS
Zh. M. Loretsyan 26 May 1968 13 p refs Transl. into ENGLISH from Soobshch. Byurakanskoy Observatorii and Akad. Nauk Armyanskoy SSR (USSR), 1967 Revised
(Contract NAS5-12487)
(NASA-CR-94799; ST-MR-OA-10702) CSCL 11

Discussion of certain factors relevant to the optimal choice of materials for fabricating astronomical mirrors, together with a description of some results obtained with the aluminum-magnesium alloy AMg6L coated with chromium or nickel films. The following criteria are examined: (1) resistance to thermal and mechanical deformations; (2) stability of mirror characteristics with time; (3) ease with which the material can be subjected to optical and mechanical treatment; (4) possibility of manufacturing large mirrors; (5) cost and availability of the material. The chemical composition of the AMg6L alloy is described and the material is judged to be readily available, have a high degree of stiffness, small specific weight, and resistance to thermal deformations. However, the alloy is soft and has poor chemical durability. The use of harder anticorrosive coatings, such as electrolytic chromium or chemical nickel, is suggested. Author

N68-25065 Utah Univ., Salt Lake City.
THE EFFECT OF PRESSURE ON FATIGUE
Sattley Clark Rowland (Ph.D. Thesis) 1967 127 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-3229

Studies outlined in this thesis include the fatigue testing under hydrostatic pressure of high purity iron, aluminum, and nickel samples. The development of both a resonant type and a rotating beam-type fatigue apparatus is described. Rotating beam fatigue tests were made which showed an increased fatigue life with higher confining pressures. Two distinct fatigue processes were found which can be described as crack nucleation and crack propagation. It is also found that the first process is considerably shorter under atmospheric conditions than the second. A deleterious surface effect was found with higher pressures when fatigue tests were made with aluminum. This effect was not seen in iron or nickel and a protective coating eliminated it in aluminum. Investigation into this phenomenon gave inconclusive results as to whether it was a chemical or mechanical process. Based on these observations several models of crack nucleation and propagation are considered. Dissert. Abstr.

N68-25071# California Univ., Livermore. Lawrence Radiation Lab.
EFFECTS OF THERMAL PRETREATMENT AND ALUMINUM NITRIDE ON THE AUSTENITE GRAIN SIZE
Ladislav Bezdek Feb. 1968 24 p refs Transl. into ENGLISH from Kovove Mater. (Czechoslovakia), v. 4, 1966 p 143–155
(UCRL-TRANS-10228) CFSTI: HC $3.00/MF $0.65

The thermal treatment of carbon steel deoxidized with 0.05% of aluminum exerts a considerable effect on the growth of austenite grains at the austenitizing temperature of 950°C. The austenite grains are the largest after the thermal pretreatment 1150/1h-water (or air or furnace), while they are the smallest after the pretreatment 1175 to 1300/1h-water (or air or furnace). This cannot be explained by the effect of the initial structure upon the formation and the growth of the austenite nuclei; the explanation lies instead in the influence of the thermal pretreatment on the dissolution and the agglomeration of aluminum nitride. The result of a thermal pretreatment in which AlN dissolves to a substantial extent is that, when the steel is reheated to the temperature at which AlN precipitates out, it separates out in a form that greatly suppresses the growth of the austenite grains. The temporal and thermal stability of the austenite grains (i.e., the growth of the latter) is determined not by the total amount of aluminum nitride, but by a fraction of it (active aluminum nitride) that efficiently inhibits the growth of austenite grains. Author (NSA)

N68-25079# Battelle-Northwest, Richland, Wash.
CORROSION PROBLEMS POSED BY THE USE OF AUSTENITIC CHROME-NICKEL-IRON IN THE NUCLEAR ENVIRONMENT
H. Coriou, L. Grall, and M. Pelras 8 Jan. 1968 42 p refs Transl. into ENGLISH from Energ. Nucl. (Paris), v. 9, 1967 p 303–313
(BNWL-TR-25) CFSTI: HC $3.00/MF $0.65

Aqueous corrosion studies carried out on Cr-Fe-Ni austenitic alloys used in the building of reactors or for irradiated fuel treatment

plants are described. The media chosen include: demineralized water, water vapor, chlorinated alkaline, and nitric solutions. Intergranular corrosion and stress corrosion are emphasized.
Author (NSA)

N68-25096*# IIT Research Inst., Chicago, Ill.
A STUDY OF THE ADHESION OF METALS AND NON-METALS IN AN ULTRA-HIGH VACUUM Final Report, 12 Jun. 1965–1 Jul. 1966
Anton Hehn 1 Jul. 1966 240 p refs
(Contract NAS9-4759; IITRI Proj. K6087)
(NASA-CR-62074) CFSTI: HC $3.00/MF $0.65 CSCL 11

An experimental program was conducted to determine adhesive properties of various classes of materials in contact with each other after exposure to the lunar environment. A total of 952 material combinations involving dipping or compressing spacecraft and spacesuit specimen materials into pulverized lunar soil were used. Also, 135 tests involving slinging of the pulverized lunar soil unto a vertically mounted specimen of spacecraft or spacesuit material were conducted. The material classes included metals, glasses, ceramics, polymers, and minerals. These were tested against themselves and each other. The adhesion force measurement experiments are compiled and presented in tabular form. The test data obtained from the experiments involving pulverized lunar soil materials are also presented in tabular form with the degree of surface area covered by the adhering particles as a rating parameter. These latter tables also contain information on data obtained from various cleaning or powder removal techniques. Author

N68-25109 Denver Univ., Colo.
AN EXAMINATION OF THE THERMAL ETCHING CHARACTERISTICS OF COPPER-NICKEL ALLOYS
Dennis O'Neill (Ph. D. Thesis) 1966 102 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-1544

Copper, nickel and several copper-nickel alloys were thermally etched in a vacuum of about 5×10^{-5} mm of Hg. Most of the etching temperatures of the alloys were at 83°C below the solidus on the copper-nickel phase diagram. The resulting thermal-etching morphologies were examined by electron microscopy using a replicating technique. The predominant feature of the thermally etched copper-nickel alloys was the development of many large etch pits. The thermally-etched copper and nickel were essentially void of pits. This difference between the etching behavior of the alloys and the pure metals is attributed to a decrease in the surface free energy of the parent metal as a result of alloying additions. This decrease in surface free energy promotes evaporation at ledge sources. Dissert. Abstr.

N68-25140# California Univ., Livermore. Lawrence Radiation Lab.
EFFECT OF THE FORM OF FERRITE ON THE RECRYSTALLIZATION OF STEEL IN FRACTURES
N. N. Lipchin, Yu. A. Belykh, and B. V. Gromov Feb. 1968 8 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Chernaya Met. (Moscow), v. 8, 1966 p 141–144
(UCRL-TRANS-10227) CFSTI: HC $3.00/MF $0.65

Recrystallization of steels in the original annealed condition is affected by the form in which the excess phase is precipitated. Oriented precipitation of ferrite (carbide) complicated for formation of a new grain complex. The temperature of recrystallization in fracture of steels with anomalous annealed structure is not connected with the temperature of the critical point Ac_3. The reheating temperature from which grain refinement in the fracture of steel with acicular ferrite is ensured depends on the rate of heating and on the stability of the carbide particles. Author (NSA)

N68-25150*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPACE-POWER-SYSTEM MATERIAL COMPATIBILITY TESTS OF SELECTED REFRACTORY METAL ALLOYS WITH BOILING POTASSIUM
L. Rosenblum, C. H. Scheuermann, and T. A. Moss [1968] 17 p refs Presented at the Symp. on Alkali Metal Coolants—Corrosion Studies and Sys. Operating Experience, Vienna, 28 Nov.–2 Dec. 1966
(NASA-TM-X-59596; SM-85/37) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The compatibility of potential niobium and tantalum tubing alloys with boiling potassium was investigated in the range of temperature representative of the upper operational temperatures of a turboelectric space power system. Two types of compatibility test were employed: (1) reflux capsule tests for materials screening, and (2) a forced convection two-phase loop test in which power-system flow rate and temperature gradient service conditions were simulated. In the reflux capsule tests, eight alloys were studied: B-33 (Nb-4V, nominal alloy composition in weight percent); SCb-291 (Nb-10 Ta-10W); Nb-1Zr; D-43 (Nb-10W-1Zr-0.1C); FS-85 (Nb-28Ta-10W-1Zr); Ta-10W; T-111 (Ta-8W-2Hf); and T-222 (Ta-9.6W-2.5Hf-0.01C). Many of the alloys were tested in both the as-worked and recrystallized conditions. The initial oxygen content of the alloys was less than 150 ppm and that of the potassium less than 20 ppm. Tests were conducted over the temperature range of 1800° to 2400°F for times up to 10,000 hours in vacuums of 10^{-7} to 10^{-8} torr. In general, the gettered alloys (i.e., those containing the reactive elements Zr or Hf) were resistant to corrosive attack, while the ungettered alloys all exhibited significant corrosion. Author

N68-25158# Naval Research Lab., Washington, D. C.
THE EFFECTS OF COUPLING NUCLEAR RADIATION WITH STATIC AND CYCLIC SERVICE STRESSES AND OF PERIODIC PROOF TESTING ON PRESSURE VESSEL MATERIAL BEHAVIOR
J. R. Hawthorne and F. J. Loss 25 Jul. 1967 39 p refs
(Contract AT(49-5)-2110)
(NRL-6620) CFSTI: HC $3.00/MF $0.65

The nuclear service performance of structural steels as influenced by static and cyclic stress applications during radiation exposure has been examined and documented with experimental results. The significance and merits of initial and subsequent proof tests of large structural components such as the hydrotesting of nuclear reactor pressure vessels have also been reviewed and evaluated. Performance following preload in the form of warm prestressing as well as aging embrittlement were among those factors considered. A summary review of available data representing a coupling of static stress and radiation has suggested neither a significant effect of stress on irradiation responses, nor a synergistic effect of stress and radiation on mechanical properties performance. New data also indicate that stress during irradiation may not have a general influence on post-irradiation annealing response. A parallel review of the cyclic stress behavior of pressure vessel steels did reveal a slight alteration of basic (preirradiation) low-cycle fatigue properties by neutron exposure. The general trend depicted was one of a radiation reduction of fatigue life at high strain amplitudes (low-cycle failure region) and of improvement at low strain amplitudes (high-cycle region). The trend was found consistent for both pre-post irradiation test methods and dynamic in-reactor testing. Evaluations of the merits and objections for proof testing allowed a conclusion that both initial and periodic proof tests conducted above the nil-ductility transition temperature (NDT) are of definite value; however, operations below NDT either as a proof test or subsequent to warm prestressing above NDT were found objectionable. Author (NSA)

N68-25161# Bettis Atomic Power Lab., Pittsburgh, Pa.
THE CORROSION AND HYDROGEN ABSORPTION PROPERTIES OF ZIRCALOY-4 ALLOYS CONTAINING ADDITIONS OF NIOBIUM
S. Kass Dec. 1967 23 p ref
(Contract AT(11-1)-GEN-14)
(WAPD-TM-647) CFSTI: HC $3.00/MF $0.65

Results are presented of experiments designed to measure H absorption characteristics and corrosion kinetics of Zircaloy-4 containing additions of 0.5 and 1.0% Nb. It was determined that the alloys containing Nb showed somewhat higher corrosion rates and approximately equivalent H pickup characteristics in both high-temperature water and steam compared with Zircaloy-4. It was also determined that addition of these amounts of Nb gave slightly increased strength in the alpha annealed condition without serious loss of ductility and that the properties of the alloys were not appreciably affected by metallurgical structure. It was concluded that no significant advantage was gained by the addition of Nb. NSA

N68-25247 Michigan State Univ., East Lansing.
AN ANALYTICAL AND EXPERIMENTAL STUDY OF THE THERMAL SPECTRAL PROPERTIES OF OXIDE–METAL COMPOSITE MEDIA
Syed Abdullah Hassan (Ph.D. Thesis) 1966 109 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-1634

The purpose of this study was to determine the corrosion rates of zinc and galvanized steel and to relate their optical properties to the amount of corrosion in the radiation spectrum of 0.35 to 2.75 micron wavelengths from a 10,000°R source (sun) and a 3000°R source (tungsten lamp). Samples of zinc and galvanized steel were corroded for several durations up to 3 months in outdoor atmosphere and up to 4 weeks in a spray cabinet using a continuous spray of water. The corrosion film thicknesses were measured by the weight-change method (removal of the corrosion products from the test surface), by the x-ray diffraction method and by the metallographic method. Dissert. Abstr.

N68-25264# General Dynamics Corp., San Diego, Calif. General Atomic Div.
A RESEARCH PROGRAM ON THE EFFECT OF SUBSTRUCTURE ON THE IRRADIATION STABILITY OF ASTM A302 GRADE B STEEL Final Report
T. A. Trozera and P. W. Flynn 1 Aug. 1967 95 p refs
(Contract AT(04-3)-167)
(GA-8064; EURAEC-1928) CFSTI: HC $3.00/MF $0.65

The steel was quenched and tempered A302-B steel. The tensile properties in the three principal directions of the plate were within ±2%. Several combinations of cold work and heat treatment were used to produce yield strength increases of 35% over the quenched and tempered condition while maintaining the same uniform strain. The treatment producing the best mechanical properties caused a 32°C increase in the Nil Ductility Transition. The irradiations were performed in the Low Intensity Test Reactor at <100°C and 288°C. Capsules received fast fluences in the range 1.5×10^{18} to 5.2×10^{19} nvt. Nonirradiated and irradiated samples of quenched and tempered material and of material that had been cold worked and heat treated were then tested at 22, 157, and 288°C. For the tensile and tube specimens, the load and elongation or diametral expansion were autographically recorded. Standard Charpy impact tests were performed to plot the transition temperature, and the Charpy impact machine was also instrumented to provide details on energy distribution during fracture. The yield and tensile strength of A302-B steel can be increased by suitable cold work and heat treatment without a loss in uniform elongation. This improvement persists after irradiation but does not reduce loss of uniform strain at large fluences. The predicted instability strain in the tube (biaxial) test is not exceeded and is valid as an upper limit. An appropriate cold work and heat treatment may decrease radiation sensitivity in the Charpy impact test and may also increase energy absorption in propagating a brittle fracture. Interstitials collecting on subgrain boundaries may be the key element in the observed substructure strengthening. A constant cell size appears to be reached at small amounts of cold work followed by heat treatment. Author (NSA)

N68-25289# Hawker Siddeley Aviation, Ltd., Brough (England).
THE CHEMICAL CONTOURING OF CORROSION RESISTING STEELS AND OF A NICKEL BASE ALLOY
R. Boler London Min. of Technol. Apr. 1967 37 p refs
(Contracts KP/Z/05/CB38A; KS/1/007/CB43(a)2)
(D-MAT-144) CFSTI: HC $3.00/MF $0.65

Corrosion resisting steel sheet can be chemically contoured in diluted aqua regia solution operated at 60° to 70°C. Satisfactory masking resists were found and the process was operated on a pilot scale. Methods of control of the bath were developed. The effect of the process on fatigue properties was determined. In general it caused a reduction which can be restored by subsequent vapor blasting. A nickel base alloy sheet could be contoured when sulphuric acid was added to the solution. Author

N68-25318*# Louisiana State Univ., Baton Rouge.
A STUDY OF SENSITIZATION IN TYPES 301 AND 304L STAINLESS STEELS USING MOESSBAUER SPECTROSCOPY
O. W. Albritton Washington, D. C. NASA Jun. 1968 23 p refs
(Grant NGR-19-001-024)
(NASA-CR-1077) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Mossbauer effect spectroscopy in conjunction with X-ray diffraction techniques were used to study the phenomenon of stainless steel sensitization. A ferromagnetic phase, thought to be pseudomartensite, has been found to exist in sensitized Type 301. Stresses generated in the matrix by morphology changes of the precipitated carbides is deemed responsible for the creation of this phase. No such phase was detected in the Type 304L. It was confirmed that the precipitated carbides were of the complex type. Furthermore, it was established that these carbides are paramagnetic. In the presence of austenite, the Mossbauer peak for the carbides is overshadowed. In single phase materials grain size has no effect on the Mossbauer spectrum. In multiphase materials the peak locations are unaffected by grain size, but quantitative evaluations are influenced. Author

N68-25324*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HOT SALT STRESS CORROSION CRACKING OF SHEET MATERIALS FOR A SUPERSONIC TRANSPORT
George J. Heimerl and Dick M. Royster [1967] 19 p Presented at the Symp. on Corrosion, AIME Ann. Meeting, Los Angeles, 19–23 Feb. 1967
(NASA-TM-X-59634) CFSTI: HC $3.00/MF $0.65 CSCL 11F

An extensive investigation of hot salt stress corrosion of sheet materials for a supersonic transport began in 1962. Studies included the relative susceptibility of titanium alloy and stainless steel sheet materials, environmental effects, crack initiation, residual strength, the corrosion mechanism, and protective treatments. Many of the results have been reported previously. This talk will briefly review some of the findings and discuss current results. Author

N68-25345*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RESULTS OF CURRENT STUDIES ON COATED TANTALUM ALLOY SHEET AT NASA LANGLEY RESEARCH CENTER

Bland A. Stein and Gregory R. Wichorek [1967] 19 p refs Presented at the 13th Meeting of the Refractory Composites Working Group, Seattle, 17–20 Jul. 1967
(NASA-TM-X-60249) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Consideration is given to coated tantalum alloys which are used in leading edge regions of hypersonic cruise vehicles. Results of oxidation and mechanical property tests are presented on a thin Ta-10W alloy sheet protected with a slurry-dip aluminum–tin–molybdenum coating. Refractory metal coatings used in the nose cap region of hypersonic vehicles are also discussed. An electrophoretic deposited gradated intermetallic/oxide coating is investigated as a means of solving the problem of spalling caused by thermal expansion mismatch between an oxide coating and refractory metal substrate. Oxidation tests on a thin tantalum alloy sheet with a coating of this type are reported. B.S.D.

N68-25354# California Univ., Livermore. Lawrence Radiation Lab.
DELAYED CRACKING STUDY IN U–7.5% AND Nb–2.5% Zr
C. A. W. Peterson and W. J. Steele 19 Dec. 1967 37 p refs
(Contract W-7405-ENG-48)
(UCID-15256) CFSTI: HC $3.00/MF $0.65

Two types of tests were used to evaluate the delayed cracking propensity in U–7.5% Nb–2.5% Zr (Mulberry): sustained loading near the yield strength in dry and wet air; and dynamic testing to failure over a range of strain rates (0.05 to 0.005 in./in./min) in dry air, wet air, and vacuum. Two conditions of constitution were examined: solution treated by quenching from the gamma field, and solution treated plus aging at 150°C for 1 hr. The effects of mechanical notches and pre-existing intergranular penetrations were also observed. Specimens which had been machined after heat treatment and thus presented a clean, machined surface to the atmosphere while under stress did not fail in creep or show low elongation at low strain rates. Tests to failure produced ductile fracture surfaces. Indications of surface damage by oxidation, gouging or scoring to form minute notches, and inclusions, as well as intergranular penetration and substructural contamination, are seen in the many optical and electron microstructures of brittle fractures. The gamma-quenched specimens so contaminated appeared to be more susceptible to failure in the humid environment than samples heat-treated at 150°C or machined after all heat treatments.
Author (NSA)

N68-25388 Cincinnati Univ., Ohio.
THE EFFECT OF PRECIPITATION ON ORIENTATION IN LOW-CARBON STEELS
William Le Roy Hosick (Ph.D. Thesis) 1966 172 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-1988

The difference in the development of texture in low-carbon steels with aluminum contents in the range of 0.007% to 0.125% was investigated to determine whether either Dillamore's theory of inhibition of recovery or Stickels' theory of reduced high-angle grain boundary migration describes the mechanism involved in establishing an annealed texture which is favorable to deep drawing. Electron microscopy, internal friction, (200) reflection pole figures, X-ray intensity ratios and X-ray line broadening techniques were all used to obtain a better understanding of the phenomena involved. The results show that the principal components of orientation found in the annealed texture of both rimmed and killed steels are available in the deformation texture, and the difference between the annealed textures is explained by the competitive growth of these pre-existing fragments of the principal orientations. In a rimmed steel, the components with high-angle boundaries (e.g., cube-on-edge) grow at the expense of those components with low-angle boundaries (e.g., cube-on-corner). In a killed steel, the precipitation of aluminum nitride in the high-angle boundaries during recrystallization reduces their mobility and gives a competitive growth advantage to the components near the cube-on-corner orientation (which have low-angle boundary relationships), resulting in a texture with better drawing characteristics. This mechanism is in agreement with Stickels' theory. Dissert. Abstr.

N68-25400# Joint Publications Research Service, Washington, D. C.
EFFECT OF COLD WORK ON CORROSION RESISTANCE OF 2.5% NIOBIUM-BEARING ZIRCONIUM ALLOY
I. S. Lupakov, B. S. Rodchenkov, and A. N. Gromova 22 May 1968 10 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), no. 1, Jan. 1968 p 91–94
(JPRS-45460) CFSTI: HC $3.00/MF $0.65

Effects of 5 to 40% cold working after annealing in the α and $(\alpha+\beta)$ ranges as well as of quenching and aging temperature on the corrosion resistance were determined for a 2.5% of the niobium-bearing zirconium alloy in vapor at 400°C and 100 atm for about 5,000 hr. Resultant data also indicated substantial increase in the corrosion resistance of the alloy. Weight increments in the 700°C annealed and cold worked test coupons after 4800 hr of testing consisted of 350 and 180–190 mg/decimeter^2 respectively, and the degree of their deformation had no practical effect on weight increase. Cold working after annealing in the alpha-region at 580°C slightly decreased corrosion resistance, which was higher than after annealing in the $(\alpha+\beta)$-region. Testing quenched and aged test coupons demonstrated that the best corrosion resistance was possessed by the alloy after quenching from the $(\alpha+\beta)$-region at 860°C, and cold working and aging at 400°C. M.W.R.

N68-25437# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
MAGNETIC PHENOMENA AT METAL SURFACES Technical Progress Report, 1 Jun.–31 Dec. 1967
Stephen Spooner 29 Feb. 1968 33 p refs
(Contract AT(40-1)-3674)
(ORO-3764-1; TPR-1) CFSTI: HC $3.00/MF $0.65

Cobalt and cobalt–6% iron alloy films were prepared for magnetic-property study and neutron-scattering measurements. Rotational anisotropy and hysteresis were measured using torque magnetometer techniques. There are indications of possible "ripple" structure in these films where fields in the order of 500 gauss are applied. Preliminary neutron-scattering experiments measuring total external reflection at grazing incidence have indicated the possibility of neutron polarization. Magnetic fields up to seven kilogauss were applied in the direction of the plane of cobalt mirror, and only small effects are observed. A novel technique for measuring the magnetic structure at surfaces has been devised with the application of a "magnetic needle." Based on a force measurement due to fields in the immediate vicinity of a magnetic surface, the method can be used to measure domain structure and external field variations needed for understanding of the neutron-scattering experiment.
Author (NSA)

N68-25555# Oak Ridge National Lab., Tenn. Research Materials Information Center.
GROUPS 4, 5, AND 6 TRANSITION METALS, SUPPLEMENT NO. 1. SELECTED REFERENCES ON PREPARATION, STRUCTURE, PHYSICAL PROPERTIES, METALLOGRAPHY, AND TRANSPORT PROPERTIES
[1967] 27 p refs
(Contract W-7405-ENG-26)
(ORNL-RMIC-8) CFSTI: HC $3.00/MF $0.65

A general bibliography for preparation methods, crystal structure, transport properties, and physical and mechanical properties is given for transition metals. A bibliography is also given for each of Groups IV, V, and VI for preparation methods, crystal structure, transport properties, and physical and mechanical properties.
NSA

N68-25603# Idaho Nuclear Corp., Idaho Falls.
CORROSION EVALUATION OF EQUIPMENT USED FOR REPROCESSING ZIRCONIUM ALLOY NUCLEAR FUELS
C. A. Zimmerman and T. L. Hoffman Feb. 1968 10 p refs
(Contract AT(10-1)-1230)
(IN-1134) CFSTI: HC $3.00/MF $0.65

Corrosion rates for Monel-400 and various stainless steels in process solutions were determined in laboratory studies and in plant service. The plant service period included the first reprocessing of zirconium alloy nuclear fuels using boric acid as a soluble poison during dissolution. Corrosion rates for a Monel-400 dissolver using hydrofluoric–fluoboric acid dissolvent and sulfuric and chromic acids for cleanout ranged between two and eight mils per month. Corrosion rates for stainless steel plates containing boron as a fixed poison in the first cycle product evaporator were very low. The low corrosion rates for this and other process equipment indicate that the system can be used for future reprocessing operations. Author (NSA)

N68-25646# MSA Research Corp., Evans City, Pa.
EFFECT OF HIGH TEMPERATURE SODIUM ON THE MECHANICAL PROPERTIES OF CANDIDATE ALLOYS FOR THE LMFBR PROGRAM Quarterly Progress Report, Oct.–Dec. 1967
Jan. 1968 19 p
(Contract AT(11-1)-765)
(MSAR-68-14) CFSTI: HC $3.00/MF $0.65

A program for determination of the effects of high temperature sodium on the mechanical properties of candidate alloys for the LMFBR is continuing. Test materials consisting of SS 304, SS 316, Cr–Mo steel, Croloy 5, and Croloy 5Ti have been selected, the specimens are in preparation, and the test program has been specified. Four static retorts have been installed. Operations of the test loops for high-carbon, high-oxygen, and clean sodium environments were checked. Two extensometers performed satisfactorily for short run high-temperature cycles and are undergoing further heat run testing. Surface-tension measurements were made in an attempt to develop a technique for measuring sodium impurities. NSA

N68-25651*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
INVESTIGATION OF THE REINFORCEMENT OF DUCTILE METALS WITH STRONG, HIGH MODULUS DISCONTINUOUS, BRITTLE FIBERS
A. Gatti, J. M. Berry, J. J. Gebhardt, and J. V. Mullin 1 May 1968 47 p refs
(Contract NASw-1543)
(NASA-CR-94733; Rept.-2410-2E2; QR-6) CFSTI: HC $3.00/MF $0.65 CSCL 11D

Critical factors affecting the reinforcement of ductile metals with short, brittle fibers were investigated using aluminum or its alloys and ductile epoxies and B_4C whiskers as the reinforcement. An economical process for growing whiskers, deposition parameters, and production of continuous filaments to upgrade strength were studied. Characterization of the individual constituents of the final composites involved the study of the structural and chemical interactions of the combined elements, including the fibers, matrix, and coatings. Variables affecting the tensile strength of whisker-reinforced composites are tabulated, and mechanical compatibility was used as the criterion for assessing these variables. A qualitative discussion of intermittent bonding is presented based on the significance of a bonding system that varies only as a function of filament contact area. By using stress trajectory analysis, the crack sensitivity of a matrix can be altered significant through the use of intermittent bonding. M.W.R.

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N68-24361# Sandia Corp., Albuquerque, N. Mex. Manufacturing Research Div.
MOLDED RIGID URETHANE FOAMS. 1: DIMENSIONAL CHARACTERISTICS
Ralph D. Hermansen Jan. 1968 43 p refs
(Contract AT(29-1)-789)
(SC-RR-67-810) CFSTI: HC $3.00/MF $0.65

The weight change and dimensional change of 6×6×1 inch molded foam blocks conditioned in a controlled, low-humidity chamber for a period of 60 days is described. Three urethane foam systems having distinctly different chemical structures were used to mold the foam blocks. The effect of varied processing conditions on the dimensional characteristics of the blocks was studied for mold preheat temperatures of 75°, 130°, and 180°F and for cure schedules of 8 and 16 hours at 325°F. The weight and dimensional changes predicted from gaseous diffusion are compared to the actual results. Author (NSA)

N68-24367# General Electric Co., Philadelphia, Pa. Missile and Space Div.
EQUATIONS OF STATE OF ORGANIC HIGH POLYMERS
P. S. Ku 1 Jan. 1968 60 p refs Presented at the ASME 4th Symp. on Thermophys. Properties, College Park, Md., 1–4 Apr. 1968
(Doc.-67SD320)

The two-parameter solid equations of state, the Murnaghan equation, the Tait equation, and a generalized form of the Birch equation were selected to fit the static pressure-volume isotherms of solid and liquid high polymers. These equations were found to have a wide range of applicability. They can be extrapolated to very high pressure with good accuracy. The first and second derivatives appear to be well behaved. These equations can be used to obtain analytical expressions for the Grüneisen parameter, containing the volume or pressure explicitly and temperature implicitly. They yield values that seem to be in agreement with the latest theoretical deductions. When used with the Kennedy fusion law, these isothermal equations can be used to predict melting temperatures under very high pressures. It has also been shown that these equations can be used to predict the shock compression data as influenced by the degree of crystallinity of the polymers is given. Along with the PVT properties of polymers, the specific heats (C_p and C_v) of polyethylene, polychlorotrifluoroethylene, and polytetrafluoroethylene under high pressures are evaluated. Author

N68-24431 Akron Univ., Ohio.
GAMMA-RAY INITIATED POLYMERIZATION OF VINYL MONOMERS
Carl Edward Trewiler 1966 143 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-2776

An investigation was carried out on the polymerization or attempted polymerization of the following monomers by gamma radiation ($7.1 - 7.6 \times 10^5$ rads/hr.) at low temperature (−78°C): acrylonitrile, 3-butene nitril, ethylene, fluoroethylenes, fumaronitrile, isobutene, para-nitrostyrene, perfluorobutene-2, perfluoropropylene, tetracyanoethylene, vinyl triethoxysilane and vinyl chloride. Acrylonitrile showed erratic results. 3-Butene nitrile, ethylene, perfluorobutene-2, perfluoropropylene, tetracyanoethylene and vinyl triethoxysilane were found to have extremely slow polymerization rates. The polymerization of fumaronitrile and para-nitrostyrene

could not be detected. The polymerization of the fluoroethylenes, vinyl fluoride (VF), vinylidene fluoride (VF_2) and trifluoroethylene (VF_3) is best explained by a reaction which is propagating through a cationic intermediate. Attempts to copolymerize these fluorinated monomers with such co-monomers as isobutene and vinyl chloride led to the exclusive homopolymerization of the isobutene and vinyl chloride. Dissert. Abstr.

N68-24504# General Electric Co., Schenectady, N. Y. Research and Development Center.

A KINETIC INTERPRETATION OF THE GLASS TRANSITION: GLASS TEMPERATURES OF n-ALKANE LIQUIDS AND POLYETHYLENE

A. A. Miller Mar. 1967 13 p refs

(Rept.-67-C-091)

On the basis of a kinetic criterion for the glass transition ($\eta_g = 10^{13}$ poise), theoretical T_g values were calfor n-alkane liquids by the equation $\ln \eta = \ln A + B/(T - T_0)$, using reported values for the parameters. Extrapolation to $(CH_2)_\infty$ gave $T_g = 200°K$, $T_0 = 160°K$ and $B = 1480°K$. This T_g is consistent with other estimates for polyethylene, and T_0 coincides with the temperature at which the "excess" liquid entropy becomes zero for $(CH_2)_\infty$ from thermodynamic data. The T_g/T_0 ratio reaches a limiting value of 1.25 at $C_{12}H_{26}$ and the "W.L.F. term" is remarkably constant for the entire series, $\lambda_g = (T_g - T_0)/B = 0.0269$. For polymer liquids it is proposed that $E_o = RB$ is determined by the internal barriers to rotation for the "isolated" polymer chains. Thus, E_o (kcal/mol) = 2.9 for polyethylene, 3.0 for polystyrene, and 5.7 for polyisobutylene. Author

N68-24527# Massachusetts Univ., Amherst. Polymer Research Inst.

THE DICHROISM AND BIREFRINGENCE OF POLYMERS CONTAINING POLYENE SEGMENTS, PART 2

Y. Shindo and R. S. Stein Jan. 1968 26 p refs

(Contract Nonr-3357(01))

(ONR-TR-92; AD-666625)

The theory of birefringence and dichroism of oriented polyene containing polyvinyl chloride is extended to the case where the number of polyene segments is small. A modification of the equations proposed in a previous report (AD-657 352) is required in this case. Author (TAB)

N68-24581# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.

FIBROUS FORMS OF CARBON

O. Vohler and E. Sperk May 1967 21 p refs Transl. into ENGLISH from Ber. Deut. Keram. Ges. (Bonn), v. 43, no. 3, 1966 p 199–208

(AERE-TRANS-1079) HMSO: 3s

Carbon has been used for some time now in the form of flexible fibres. Originally these carbon felts, cloth, yarns and wools were made exclusively with a cellulose base. Later these materials were replaced by synthetic and animal fibres. The uses of fibrous carbon are largely determined by its outstanding thermal and electrical properties and its fibrous quality. Because of their high heat-insulation properties carbon felts and wools are used first of all as a high-temperature insulating material. Its electrical properties are utilized for flexible heating elements (e.g. graphite cloth). In the same manner as glass fibre is used to reinforce plastics, fibrous carbon and fibrous graphite can be employed to strenghten plastics used, for instance, in ablative cooling. Likewise graphite bodies can be reinforced by fibrous carbon. Author

N68-24583# Massachusetts Univ., Amherst. Polymer Research Inst.

THE POLARIZATION OF FLUORESCENT LIGHT FROM A UNIAXIALLY ORIENTED RUBBER

R. S. Stein Feb. 1968 25 p refs

(Contract Nonr-3357(01))

(ONR-TR-102; AD-666623)

The polarization of fluorescence from a polymer characterizes two segment orientation functions, fs(2) and fs(4). These may be calculated as a function of elongation using the kinetic theory of rubber elasticity. Three cases are considered: (a) the transition moment direction lies parallel to the segment axis and does not change its orientation during the lifetime of the excited state, (b) the transition moment direction lies at an angle to the segment axis, and (c) the transition moment changes its orientation during the lifetime of the excited state. Author (TAB)

N68-24584# Massachusetts Univ., Amherst. Polymer Research Inst.

THE EFFECT OF BIREFRINGENCE ON LOW ANGLE LIGHT SCATTERING PATTERNS FROM ORIENTED POLYMER FILMS

R. S. Stein, P. F. Erhardt, and W. Chu Dec. 1967 16 p refs

(Contract Nonr-3357(01))

(ONR-TR-101; AD-666624)

The effect of birefringence of a polymer film upon its photographic light scattering pattern is considered for the case of a single anisotropic two-dimensional spherulite imbedded in a birefringent matrix. It is shown that for the case of a polarizer and analyzer crossed at +45 deg. and -45 deg. to the analyzer the scattering pattern is modified in a manner agreeing with experimental observation. Author (TAB)

N68-24585# Massachusetts Univ., Amherst. Polymer Research Inst.

TIME-DEPENDENCE OF CRYSTAL ORIENTATION IN CRYSTALLINE POLYMERS

R. S. Stein Nov. 1967 31 p refs Sponsored in part by Army, NSF, and Am. Chem. Soc.

(Contract Nonr-3357(01))

(ONR-TR-96; AD-666622)

The results of two methods for studying molecular processes accompanying the deformation of polyethylene are described. The examination of spherulite deformation by observing light scattering patterns along with measurement of the birefringence, stress and strain during the rapid extension of polyethylene shows that this initial structural deformation is essentially instantaneous. Dynamic x-ray diffraction shows that this is followed by a slower relaxation involving change in the orientation of the crystals by two processes, the lower temperature one involving slipping of lamellae past each other and the higher temperature one involving viscoelastic flow of the crystals. Author (TAB)

N68-24651# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

RADIATION INDUCED COPOLYMERIZATION OF STYRENE WITH POLYESTER FOIL AND CORD [RADIACYJNE SZCZEPIENIE STYRENU NA FOLII ORAZ KORDZIE Z POLITERE FTALANU ETYLENOWEGO]

Zofia Burhak and Waclaw Zielinski 1967 12 p refs In POLISH; ENGLISH summary

(INR-841/XVII/C) CFSTI: HC $3.00/MF $0.65

Graft-copolymerization of styrene with commercially available cord and polyester foil was achieved using a radiation technique. Strength and adhesive properties of copolymers were estimated. The influence of temperature, solvents concentration, and absorbed dose on the effectiveness of the grafting was determined. Modified cord exhibited a decrease in strength but a small increase of adhesiveness to the rubber. Author (NSA)

N68-24715# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

THE TEMPERATURE AND POROSITY DEPENDENCE OF THE MODULUS OF RIGIDITY AND POISSON'S RATIO OF BERYLLIA

J. W. Kelly and J. F. Whatham Aug. 1967 11 p refs

(AAEC/TM-402)

Using torsional equipment designed for the task, the modulus of rigidity of isostatically pressed and sintered beryllia was determined as a function of temperature and porosity. The temperature dependence was given by $G_t = G_{20}(1 - at)$, where G_t is the modulus at t°C, G_{20} is the modulus at 20°C and a is a constant approx. 3×10^{-5} deg C independent of porosity up to 800°C. Porosity dependence was given by $G_t = G_o(1 - bP)$, where G_o is the modulus at zero porosity, P is the fractional volume porosity and b is a constant approx. 1.58 independent of temperature up to 800°C. Poisson's ratio was found to be 0.30 ±0.05 and was independent of both temperature and porosity.

Author (NSA)

N68-24724# Lockheed Missiles and Space Co., Palo Alto, Calif.

STRESS STATE AND MECHANICAL PROPERTIES OF COMPOSITES [TERMOPROCHNOST MATERIALOV I KONSTRUKTIVNYKH ELEMENTOV]

A. I. Somov and O. V. Chernyi 1967 10 p refs Transl. into ENGLISH from Naukova Dumka (Kiev), no. 4, 1967 p 76-85

As the inclusion of stiff and strong fibers substantially influences stress distribution in a solid, consideration is given to the stress fields occurring in composites subjected to external loading. Data are presented to show that the nature of this influence and the magnitude of the perturbation depend on the magnitudes of the elastic moduli of the matrix medium and the inclusion, the shape and size of the inclusion, its orientation relative to the line of action of the external forces, and the kind of deformation of the matrix and the inclusion. It is pointed out that the strength and deformability of a composite are determined by the corresponding fiber characteristics, and the role of the matrix is reduced to that of a binder transmitting the external loading to the fibers. A model of a composite is examined in order to clarify the conditions under which a composite may combine high strength and satisfactory deformability, and to analyze some peculiarities in the mechanical behavior of fiber materials. M.G.J.

N68-24793# Massachusetts Inst. of Tech., Cambridge. California Univ., Livermore. Lawrence Radiation Lab.

A STUDY OF RADIATION-ACCELERATED CREEP IN POLYCARBONATE Final Report, Jul. 1960-Jun. 1967

Robert H. Mayer and Allan S. Hoffman Jun. 1967 34 p refs Prepared by Calif. Univ., Livermore. Lawrence Radiation Lab.

(Contract W-7405-ENG-48)

(UCRL-13328) CFSTI: HC $3.00/MF $0.65

The creep of polycarbonate during irradiation is being investigated. It has been found that the creep rate of polycarbonate is greater during irradiation than before or after irradiation. Similar behavior occurs in other polymeric materials such as polystyrene and polymethyl methacrylate. Unlike the other materials polycarbonate exhibits an induction period during which the creep rate is virtually unaffected by the radiation. A cursory investigation of the effects of temperature, stress, pre-quench treatment, and sample thickness has been made on the creep of polycarbonate. Modifications of the equipment (creep and radiation) have been completed so that more reliable results can be obtained and these results will be amenable to analysis by an Eyring-type rate equation. Density measuring equipment has been constructed. Studies on normal (non-radiation) creep of glassy polymers (polymethyl methacrylate) have shown that density has a very strong effect. Quenching, which affects density, has a considerable effect on creep during irradiation. Creep during irradiation of other polymeric materials has been utilized to study the cause of accelerated creep previously found to be caused by the gases produced during irradiation. Based on this cause polyisoprene would not be expected to exhibit accelerated creep because it is a rubber and thus has a much greater gas permeability than the glassy materials studied, and the gas produced is hydrogen, which has a high diffusivity. As expected polyisoprene exhibits no accelerated creep during irradiation. The mechanism by which gases cause a temporary increase in creep rate is proposed to be that the gases contribute local free at their site of production. To verify the cause of the induction period, polyethylene terephthalate was studied because it has a structure similar to polycarbonate and most of the gases produced during irradiation are given off at sites of high local free volume. The creep curves of polyethylene terephthalate exhibit an induction period during the first few minutes of irradiation. No accelerated creep was observed in cold drawn nylon 6-6 or H-film. High density polyethylene exhibits a discontinuous form of accelerated creep during irradiation. NSA

N68-24854 Pennsylvania State Univ., University Park.

ELASTIC ANISOTROPY OF SINGLE-CRYSTALS AND THE POLYCRYSTALLINE ISOTROPIC ELASTIC MODULI OF SOLIDS

Dae-hyun Chung (Ph.D. Thesis) 1966 223 p

Available from Univ. Microfilms: HC $10.15/MF $3.00 Order No. 67-1914

The elastic constants of both single-crystalline and polycrystalline MgO have been determined from 77° to 1200°K by a Foerster-type resonance method. From these data, the temperature dependence of the elastic anisotropy of MgO single-crystals has been evaluated and correlated with the temperature dependence of the polycrystalline isotropic moduli. Also determined are the isotropic moduli of polycrystalline ZnO, TiO_2 (Rutile), and α-Al_2O_3 for a similar temperature range. Additionally, room-temperature elastic moduli of polycrystalline CaF_2, CdTe, ZnSe, β-Zns and MgF_2 were determined; these isotropic moduli were then compared with isotropic constants calculated from the corresponding single-crystal data. It has been shown that all crystals are elastically anisotropic but a polycrystalline aggregate made from these crystals is isotropic in its elasticity and that the Voigt–Reuss–Hill (VRH) approximation describes the polycrystalline elastic behavior of these crystals. The VRH approximation has been found to hold for hexagonal, tetragonal, and trigonal crystals as well as for cubic crystals.

Dissert. Abstr.

N68-24904# BTR Industries, Ltd., London (England).

STRESS/TIME/ENVIRONMENTAL EFFECTS ON THE PROPERTIES OF A GLASS REINFORCED EPOXIDE RESIN LAMINATE

J. B. Cameron London Min. of Technol. Jun. 1967 26 p refs

(Contract KS/1/0150/C.B.43(a)2)

(D-MAT-145) CFSTI: HC $3.00/MF $0.65

The effects of the long term application of static loads in tension on a glass fabric reinforced epoxide resin laminate, when immersed in a variety of environments, are described. The stress rupture and residual strength characteristics are discussed. Stress rupture levels are considerably dependent on stress level. Methods for the prediction of stress rupture are examined and a glass corrosion mechanism tentatively proposed to explain decay.

Author

N68-25010*# University of Southern Calif., Los Angeles. Dept. of Chemistry.

COMPARATIVE STUDIES OF THE SOLUTION PROPERTIES OF VINYL AROMATIC POLYMERS Final Report

L. Utracki (Weizmann Inst. of Sci.) and R. Simha (Weizmann Inst. of Sci.) Apr. 1968 43 p refs
(Contracts NAS7-100; JPL-951836)
(NASA-CR-94786) CFSTI: HC $3.00/MF $0.65 CSCL 11I

Viscosity and NMR studies of poly-1-vinylnaphthalene, poly-2-vinylnaphthalene, and polyvinylbiphenyl solutions were carried out over a range of temperatures. Two transition temperatures, 20°C and 50°C, are found. The analysis of [η]-T-M relations yields the short and long range interaction parameters as a function of temperature. The conformational parameter and the temperature coefficient have been evaluated. From the NMR studies of P2VN-68 solutions the activation energy of the main transition at 50°C is calculated as $E = 23 \pm 4$ kcal/mol for 100% polymer, indicating strong hindrance of motions. The transition has been ascribed to motions of the backbone chain. Author

N68-25094# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
THE THERMAL CONDUCTIVITY OF PITCH-BONDED GRAPHITES
Dj. Krstic and T. Perme Jan. 1968 21 p refs
(NIJS-R-517) CFSTI: HC $3.00/MF $0.65

The temperature dependence of the thermal conductivity was measured for impregnated and not-impregnated Yugoslav pitch-bonded graphite. A dozen of specimens were measured parallel or perpendicular to the extrusion plane using two different technics: with the apparatus for the measurement of λ by the comparative heat flow method in the temperature range +30°C to +265°C, and with the apparatus for the measurement of λ by the radial heat flow method in the temperature range from −182°C to +405°C. The specimens have an anomalous temperature dependence of the thermal conductivity. It is easely seen from the measurements that λ of the impregnated graphite has a minimum about 80°C. Author

N68-25121 New York State Univ., Syracuse. Coll. of Forestry.
CRYSTAL AND MOLECULAR STRUCTURE OF XYLAN AND ITS CRYSTALLIZATION
William Joseph Settineri (Ph.D. Thesis) 1966 166 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-2767

Poly-β-D-1,4-anhydroxylose (xylan) has been studied with regard to its molecular and crystal structure. A method was developed whereby oriented crystalline film strips of the polymer were obtained which yielded oriented fiber diagrams on irradiation with X-rays. The pseudohexagonal unit cell proposed has allowed indexing of all diffraction maxima. A directly measured fiber repeat distance and systematic absences along the meridian of the diagram indicated a threefold-screw axis of symmetry parallel to the fiber axis. Evidence was obtained which shows this axis to be at least an element of molecular symmetry. Dissert. Abstr.

N68-25237 Michigan State Univ., East Lansing.
INFRARED PHOTOELASTICITY: PRINCIPLES, METHODS, AND APPLICATIONS
Gary Lee Cloud (Ph.D. Thesis) 1966 204 p
Available from Univ. Microfilms: HC $9.25/MF $3.00 Order No. 67-1609

An investigation was undertaken with the primary objective of extending photoelastic methods of stress analysis into the infrared portion of the electromagnetic spectrum. A review of the basic concepts and equations of photoelasticity serves to demonstrate that the methods of measurement of birefringence are not limited to the visible spectrum. Apparatus and techniques for observing and measuring birefringence in the infrared were developed. These methods were then employed in the study of stress birefringence in a broad range of wavelengths for various materials, including semiconductors. Monochromatic radiation in the range of wavelengths between 405 nm and 1900 nm was obtained by selective filtering of spectral sources and isolation of a narrow band of wavelengths from white radiation through the use of interference filters. Dissert. Abstr.

N68-25294*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SPACE ENVIRONMENTAL EFFECTS ON SEVERAL POLYMERIC AND METALLIC MATERIALS
John P. Mugler, Jr. 21 Apr. 1967 11 p refs Presented at the 11th Natl. Symp. of the Soc. of Aerospace Mater. and Process Engr., St. Louis, 19–21 Apr. 1967
(NASA-TM-X-59743) CFSTI: HC $3.00/MF $0.65 CSCL 11

Various research programs are reviewed in which the effect of space environment on materials are studied. The programs involve space environmental effects on some polymeric materials and the adhesion of metals in ultrahigh vacuum. Author

N68-25337*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GLASS-, BORON-, AND GRAPHITE-FILAMENT-WOUND-RESIN COMPOSITES AND LINERS FOR CRYOGENIC PRESSURE VESSELS
Morgan P. Hanson 1967 26 p refs Presented at the NASA-Case Inst. of Technol. Conf. on Cryog. Polymers, Cleveland, 25–27 Apr. 1967
(NASA-TM-X-60524) CFSTI: HC $3.00/MF $0.65 CSCL 11D

Tensile and interlaminar shear strengths are reported of NOL rings at 297°, 77° and 20°K. Filament translation efficiencies are compared. Cryogenic cyclic life of aluminum liners in glass filament-cylinders is reported. Author

N68-25367*# Case Western Reserve Univ., Cleveland, Ohio.
MECHANICAL PROPERTIES OF POLYETHYLENE TEREPHTHALATE UNDER SELECTED CONDITIONS AND METHODS OF PREPARATION Semiannual Progress Report, Period Ending 31 Oct. 1967
J. L. Koenig, M. D. Mele, P. H. Geil, Eric Baer, and C. D. Armediades 1968 26 p refs
(Grant NGR-36-003-054)
(NASA-CR-94780) CFSTI: HC $3.00/MF $0.65 CSCL 11I

The effects of draw ratio and draw temperature on the heats of transition of polyethylene terephthalate (PET) were studied. These values were measured with a dynamic microcalorimeter. Crystallinity was evaluated through density measurements and orientation by X-ray diffraction patterns. The results are used to deduce the mechanism by which PET crystallizes and orients upon drawing, and they are also correlated with previous results obtained by infrared and morphological studies. Morphological research was conducted on PET to determine its modular structure, to determine the original and reproduce variations in the module size in order to determine their effect on mechanical properties, and to extend morphological research on PET to polycarbonate. Additional research was conducted to study the effect of molecular organization in PET on its mechanical properties at cryogenic temperatures, using a torsional pendulum capable of measuring low levels of internal friction. Emphasis was on optimizing the operation of the torsional pendulum and improving the accuracy of its measurements. R.N.A.

N68-25413*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HEAT-SHIELD MATERIALS DEVELOPMENT FOR VOYAGER
Louis F. Vosteen [1967] 23 p refs Presented at the 3d Intern. Symp. on High Temp. Technol., Pacific Grove, Calif., 17–20 Sep. 1967
(NASA-TM-X-60531) CFSTI: HC $3.00/MF $0.65 CSCL 11I

The moderate entry heating environment predicted for out-of-orbit entries into the Mars atmosphere has led to the development of new ablation materials with densities less than 350 kg/m^3. These new materials along with previously available denser materials are being evaluated for their application to Mars-entry vehicles of the type proposed for Voyager. Initial evaluation results are presented, including ablative performance in simulated entry environments, RF transmission loss through thermally degraded material, and flexibility at low temperatures following sterilization and vacuum exposure. Most materials retained some flexibility to temperatures as low as −100°C. At −130°C, however, most materials exhibited brittle behavior. Several low density filled silicones demonstrated good thermal performance, but only two materials (which are not highly efficient thermally) had acceptable RF transmission. Author

N68-25516# Japan Atomic Energy Research Inst., Tokyo.
RADIATION DAMAGE OF LOW PERMEABILITY GRAPHITE AND HARD CARBON
Toshio Masuyama Mar. 1968 27 p refs Transl. into ENGLISH from J. Atomic Energy Soc. (Japan), v. 8, no. 4, Apr. 1966 p 185–194
(NSF-TR-102) CFSTI: HC $3.00/MF $0.65

After irradiation and annealing at 1200°C, the effects of irradiation on hard carbon and nuclear graphite were investigated by measuring the dimensional change, mechanical strength, modulus of elasticity, X-ray diffraction patterns, and low-temperature thermal conductivity. Results show that the gas permeability of low-permeability graphite increased with irradiation due to the damage of impregnated hard carbon at high temperatures. After heat treatments at various temperatures, the thermal conductivity of irradiated graphite showed a reverse annealing effect. Tabulated data are presented on the change in mechanical properties due to irradiation on nuclear graphite and hard carbon, and thermal conductivity of hard carbon, and low-permeability graphite. B.S.D.

N68-25632# Bettis Atomic Power Lab., West Mifflin, Pa.
CONTRIBUTION TO THE STUDY OF OXYGEN SELF-DIFFUSION IN REFRACTORY OXIDES: APPLICATION TO UO_2
Pierre Contamin and Rene Stefani Apr. 1967 29 p refs Transl. into ENGLISH from Comm. a l'Energie Atomique Rept. CEA-R-3179
(WAPD-TRANS-83; CEA-R-3179) CFSTI: HC $3.00/MF $0.65

A method is described for O_2 self-diffusion profile determination in solid UO_2 samples, with a possible extension to other refractory oxides. A thin (10 to 20 microns) layer of enriched oxide $U^{18}O_2$ ($^{18}O/^{16}O + {}^{18}O = 75\%$) is allowed to diffuse into a semi-infinite medium of natural UO_2; upon grinding successive layers of definite thickness, the isotope concentration ratio is determined by spark-source mass-spectrometric analysis on the surface of the massive sample. The spark trace does not exceed a depth of 10 microns and the diffusion zone covers more than 50 microns, corresponding to a variation of the concentration ratio larger than 100. This method gave values for self-diffusion of $(1.3 \pm 0.2) \times 10^{-10}$ and $(3.4 \pm 0.9) \times 10^{-10}$ cm^2/sec for 2 experiments at 1020°C. Author (NSA)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N68-24393# California Inst. of Tech., Pasadena. Dept. of Mathematics.
COMBINATORIAL CONFIGURATIONS
H. J. Ryser [1967] 20 p refs
(Contract N00014-67-A-0094-0010)
(AD-667468)

In this paper a few theorems on (0, 1)-matrices are investigated that deal with configurations in one capacity or another. The main new result is a generalization of an interesting theorem by Fulkerson and Gross on matrices with the consecutive 1's property. TAB

N68-24434# Instituto de Energia Atomica, Sao Paulo (Brazil). Service de Calculo Analogico e Digital.
BESSEL FUNCTIONS CALCULATIONS, PROGRAMMED IN FORTRAN 2 FOR IBM 1620 DIGITAL COMPUTER, MODEL 2 [CALCULO DAS FUNCOES DE BESSEL PROGRAMACAO EM FORTRAN 2 PARA COMPUTADOR DIGITAL IBM 1620, MODELO 2]
Lucia Faria Silva Apr. 1967 71 p refs in PORTUGUESE; ENGLISH summary
(IEA-138) CFSTI: HC $3.00/MF $0.65

This report outlines a set of programs developed for Bessel functions calculation. The programs may also be used like subprograms in many other calculations, as well as single programs. They are developed in Fortran II language, and were processed in a IBM 1620-Mod. 2 Digital Computer, provided with Monitor I System. Comments about accuracy of expressions chosen, Fortran lists, flow charts, as well as numerical examples, are presented. Author

N68-24443# General Electric Co., Louisville, Ky. Major Appliance Labs.
A TECHNIQUE FOR PROBABILITY ASSIGNMENT IN DECISION ANALYSIS
W. D. Lamb 13 Mar. 1967 20 p refs
(Rept.-67MAL02)

The decision-making process almost invariably requires a choice of action in the face of uncertain future events. Probability theory permits one to analyze these uncertainties quantitatively. Others have shown that probabilistic models not only yield quantitive measures of risk, but often lead to predictions quite different from deterministic models. One critical problem in using probabilistic models is the numerical encoding of uncertainty in a probability distribution. This paper presents a technique for probability assignment using the Weibull probability density. Three advantages of the Weibull density function are: (1) 'fits' any form of information (symmetric or skewed in either direction), (2) mathematical ease in fitting the distribution, and (3) simplicity, hence economy, in using the distribution in a computer simulation program. The application of the technique is demonstrated in a simple example. Author

N68-24445# Wisconsin Univ., Madison, Wis. Dept. of Statistics.
AN INTRODUCTION TO LINEAR MODELING OF STATIONARY AND NON-STATIONARY TIME SERIES
Donald G. Watts Aug. 1967 49 p refs
(Contract Nonr-1202(17))
(TR-129; AD-667472)

Recent work by G. E. P. Box, of the University of Wisconsin, and G. M. Jenkins, of the University of Lancaster has led to simple models for stationary and non-stationary time series. The approach used is essentially that proposed by Zadeh and Ragazzini in 1950 and 1952, but Box and Jenkins have looked at the problem from the point of view of the statistician. Thus, while Zadeh and Ragazzini were concerned with analytic reduction of random processes to white noise, Box and Jenkins are concerned with empirical reduction of time series to uncorrelated residuals. Another important aspect of Box and Jenkins work is that of developing useful models for seasonal time series. This paper presents an introduction to parametric modeling of time series, using the Box-Jenkins approach. Author (TAB)

N68-24484# General Electric Co., Syracuse, N. Y. Electronics Lab.
ON SEARCHING FOR SIGNIFICANT RELATIONSHIPS
S. B. Akers, Jr. May 1967 21 p refs
(R67ELS-46)

Given a large set of data in the form of individual case histories, it is often of interest to discover statistically significant relationships between the various parameters involved. This paper describes a search procedure for automatically finding such relationships. The discussion is given in terms of searching medical records, but the techniques apply equally well to equipment failure reports, personnel records, intelligence reports, and criminal files. The basic procedure rests on a measure of significance which leads to a straightforward hill climbing technique. Related problems involving understandability, interest, and novelty are also discussed.
Author

N68-24526# Toronto Univ. (Ontario). Dept. of Computer Science.
THE NUMERICAL INTEGRATION OF ORDINARY DIFFERENTIAL EQUATIONS Final Scientific Report, 30 Oct. 1966–30 Sep. 1967
T. E. Hull 25 Mar. 1968 45 p refs Sponsored in part by NRC of Can.
(Grant AF-AFOSR-673-66)
(AFOSR-68-0712; AD-667878)

The paper draws attention to several particularly promising areas of research in the numerical integration of ordinary differential equations. One area is the development of special methods for special problems such as stiff equations. A second concerns a rigorous theory for the computing procedures used in practice, taking account of the fact that the step-size is not infinitesimal, and including the use of error criteria for controlling step-size. A third concerns the determination of bounds on the propagated error, using interval arithmetic or ellipsoidal bounds, and the analogy with control theory. Another involves assessing relative merits of methods in terms of their costs with respect to specified problems.
Author (TAB)

N68-24585*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
THE DISTRIBUTION AND PROPERTIES OF A WEIGHTED SUM OF CHI SQUARES
A. H. Feiveson and F. C. Delaney Washington May 1968 42 p refs
(NASA-TN-D-4575) CFSTI: $3.00 CSCL 12A

A study of some of the properties of a weighted sum of chi-square random variables is presented, including the derivation of approximations to the distribution of this sum and an evaluation of the Welch approximation for the distribution of the test statistic in the Behrens–Fisher problem. The study indicates that if equal sample sizes are selected, the Welch approximation to the Behrens–Fisher problem may be safely used.
Author

N68-24587# LTV Electrosystems, Inc., Dallas, Tex. Greenville Div.
A TECHNIQUE FOR THE APPROXIMATION OF FUNCTIONS
W. R. Schucany May 1968 14 p refs
(G3681.21.01B)

Several nonlinear transformations which pertain to the evaluation of infinite series and improper integrals of the first kind are discussed. Some new transformations are introduced and their reapplication is shown to produce some new series expansions for improper integrals. Several examples of the application of the theory are included.
Author

N68-24643# Lockheed Missiles and Space Co., Sunnyvale, Calif.
EVALUATION OF INTEGRALS OF OSCILLATING FUNCTIONS BY USING INTERPOLATION OVER NODES OF GAUSS QUADRATURES
N. S. Bakhvalov and L. G. Vasil'eva 1968 7 p refs Transl. into ENGLISH from Zh. Vychisl. Mat. i Mat. Fiz. (USSR), vol. 18, no. 1, 1968 p 175–181

A method is proposed for constructing quadratures when the nodes of the Gauss quadrature formula are taken as interpolation nodes, i.e., the zeros of the Legendre polynomials. To confirm the validity of the method, a series of computations of approximate values of integrals was carried out, with the values calculated from recursion relations for the Legendre polynomials. Computations of Fresnel type integrals were also carried out to compare the accuracy of the derived algorithm with algorithms used previously. Error values for the described methods are tabulated.
M.G.J.

N68-24824* National Aeronautics and Space Administration, Washington, D. C.
CONVERGENCE AND SQUARE MEAN ERROR ESTIMATION IN SOLUTION OF PARTICULAR BOUNDARY-VALUE PROBLEMS FOR ELLIPTICS EQUATIONS BY THE STRAIGHT-LINE METHOD [SKHODIMOST AID SREDNEKVADRATICHNAYA OZENKA POGRESHNOSTI PRI RESHENII NEKOTURYKH KRAEVYKHZADACH DLYA ELIPTICHESKIKH URAVNENIY METODOM PRYAMKH]
V. N. Abrashin Jan. 1968 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR (Minsk), v. 11, no. 8, 1967 p 670–672
(NASA-TT-F-11452) CFSTI: $3.00 CSCL 12A

The convergence and square mean error estimate are given in the solution of some boundary value problems for elliptical equations by the straight line method. An indication is given for the possible generalization of the obtained results to the hyperplane method.
M.G.J.

N68-24978 Iowa State Univ. of Science and Technology, Ames.
SOME CONDITIONS FOR THE EXISTENCE OF RECURRENT SOLUTIONS TO SYSTEMS OF ORDINARY DIFFERENTIAL EQUATIONS
Phillip Robertson Bender (Ph.D. Thesis) 1966 42 p Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-2062

In this paper, the classical results of dynamical systems are applied to systems of nonautonomous differential equations, following the work of R. K. Miller and G. R. Sell. For the system $x' = f(t,x)$, the compact open topology is used to define a closed hull, F^*, of translates of f. Strongly recurrent functions are defined to coincide with functions which have recurrent motions in the dynamical system of Bebutov. Such functions are studied, and sufficient conditions are developed for the existence of recurrent solutions to the systems $x' = f(t,x)$ and $x' = g(t,x)$, where g is in F^*. In the closing section, the class of almost automorphic functions introduced by Bochner is restricted to those having the whole set of real numbers for its domain. Then its relation to the classes of strongly recurrent and almost periodic functions is studied.
Dissert. Abstr.

N68-24979 Texas Univ., Austin
A LATTICE OF PARTITIONS ON A GROUP
Charles Harry Carlisle, 4th (Ph.D. Thesis) 1966 94 p Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-3258

Those partitions of a group G, which may be obtained from the orbits of subgroups of the left regular representation of G times its conjoint, form a lattice. General theorems concerning the relation between the structure of this lattice and the internal structure of G are developed. It is shown that the sub-lattice of all partitions below the coset decomposition of G with regard to

its commutator subgroup is a family invariant according to the definition of Philip Hall. This result is extended by a suitable alteration of the definition of family. Dissert. Abstr.

N68-24996 Missouri Univ., Columbia
A STUDY OF THE SAMPLING DISTRIBUTIONS OF SEVERAL RATIO ESTIMATORS FOR SMALL SAMPLE SIZES
Raymond William Bowman (Ph.D. Thesis) 1966 134 p Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-2848

In this study, four ratio estimators, which are designated as simple, Quenouille's, Beale's and modified ratio estimators, are compared with respect to efficiency, bias and form of their respective sampling distributions. The study is concerned with the determination of the best ratio estimator, with respect to the above characteristics, for those cases where the sample size is small. The Hartley–Ross ratio estimator also is discussed and compared to the other ratio estimators, but on a less extensive basis. In addition, the estimates of the variances of the simple and Quenouille ratio estimators are studied and compared with respect to efficiency, bias and form of their respective sampling distributions. Consideration also is given to whether the sample mean $\bar{x}$ or the population parameter $\bar{X}$, if it is known, should be used in the estimate of the variance of the simple ratio estimator. Dissert Abstr.

N68-25081 Maryland Univ., College Park.
EXISTENCE, UNIQUENESS, AND CONVERGENCE OF SUCCESSIVE APPROXIMATIONS FOR ORDINARY AND HYPERBOLIC PARTIAL DIFFERENTIAL EQUATIONS
Beatriz Margolis (Ph.D. Thesis) 1966 133 p Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-2341

This paper intends to give a unified treatment to certain existence and uniqueness problems posed by ordinary differential equations of arbitrary order, and hyperbolic partial differential equations in canonical form of arbitrary order and number of variables, pointing out their strong similarity, which until now has been done only partially and for a very special case. Chapter I deals with the characteristic problem, while Chapter II deals with non-characteristic problems. Dissert. Abstr.

N68-25082 Texas Univ., Austin.
ERROR BOUNDS ON NUMERICAL SOLUTIONS OF DIRICHLET PROBLEMS FOR QUASILINEAR ELLIPTIC EQUATIONS
Thurman Gustav Frank (Ph.D. Thesis) 1966 150 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-3280

In this paper, finite difference approximations to Dirichlet problems for quasilinear, uniformly elliptic partial differential equations are studied. Convergence, with decreasing mesh width h, of solutions of finite difference analogues to the solution of the given continuous problem is established by means of bounds on the error in the solutions of the finite difference problems. A finite difference analogue of the Dirichlet problem is formulated by the use of central divided differences except at points near the boundary. Two alternative approximations for use at points near the boundary are studied. The error equations are linearized, and bounds are obtained on solutions of Dirichlet problems for the linearized error equations. These bounds, which are $O(hp)$, $p \geq 1$, are shown to apply to Dirichlet problems for the original nonlinear error equations by the use of a fixed-point argument. By this means, it is shown that the solutions of the finite difference analogues converge, with decreasing mesh width h, to the solution of the problem. Dissert. Abstr.

N68-25430*# Kent State Univ., Ohio. Dept. of Mathematics.
RANDOM GRAPHS AND PROBABILITY MODELS
T. N. Bhargava and D. L. Fisk (Northwestern Univ.) May 1967 12 p refs Presented at the 36th Session of the Intern. Statist. Inst., Sydney, 28 Aug.–8 Sep. 1967
(Grant NsG-568)
(NASA-CR-84674; TR-22) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Preliminary results are presented from the theory of random graphs, diagraphs, and their evolution as a time-dependent process. The main ideas come from the work of Erdös and Rényi, who describe a random graph as an independent trials stochastic process. The number, N, of edges in the graph is kept to be fixed, $0 \leq N \leq (n/2)$. Evolution of a random digraph (directed graph) may similarly be described. Another approach similarly carried over to digraphs is that of Gilbert, in which N itself is a random variable. Specific situations are studied for the case when the number of diedges (directed edges) in a random digraph remain fixed by virtue of the fact that either the valencies (number of diedges starting from a point), or the densities (number of edges terminating at a point) or both remain fixed throughout the evolutionary process. The case when both the valencies and the densities are random variables gives rise to the varying number of diedges. A formal description of a multiple Markovian process for varying densities but fixed valencies is also given. Author

N68-25458*# Kent State Univ., Ohio. Dept. of Mathematics.
MATHEMATICAL MODELS IN MANAGEMENT SCIENCES (1): CONSUMER BEHAVIOUR AS A MARKOV PROCESS
T. N. Bhargava and V. N. Patankar May 1967 8 p refs Presented at 36th Sess. of the Intern. Statis. Inst., Sydney, 28 Aug.–8 Sep. 1967
(Grant NsG-568)
(NASA-CR-84673; TR-23) CFSTI: HC $3.00/MF $0.65 CSCL 12A

The aim of this paper is to present the consumer behavior pattern which takes place in time as a simple Markov process but not necessarily with all the usual restrictions, such as stationarity and homogeneity. Difficulties caused by the complex situations found in practice are taken into account, and methods are suggested for analyzing such processes. Cases are examined where an individual consumer may be allowed to choose more than one brand and where the actual amount of the particular brand bought by the individual plays a significant role. Discussed in particular are the models based on individual and collective Markov processes for consumer purchasing behavior. Author

N68-25464 Tulane Univ., New Orleans, La.
LATTICE-ORDERED GROUPS
Richard Dowell Byrd (Ph.D. Thesis) 1966 98 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-3835

Throughout this abstract G will denote a lattice-ordered group ("l-group"). Some definitions, notation, and terminology which are used in the dissertation are introduced. An investigation of those properties of polar which can be extended to M-polars are described proven that the collection of all M-polars for a fixed convex l-subgroup M of G is a complete Boolean algebra. Also it is shown that the collection of all M-summands is a subalgebra of the collection of all M-polars. It is shown that the collection of all prime filters on G is in one to one correspondence with the collection of all prime subgroups of G. Under this correspondence ultra-filters are mapped onto minimal prime subgroups. Dissert. Abstr.

N68-25468 Washington Univ., Seattle.
PREDICTION THEORY OVER DISCRETE ABELIAN GROUPS
David Magill Eaves (Ph.D. Thesis) 1966 60 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-2150

A Stationary Stochastic Process (SSP) over a discrete Abelian group $\overline{G}$ is a map X from $\overline{G}$ into a Hilbert space, such that the inner product $<X(\kappa), X(\Delta)>$ depends only on $\Delta - \kappa$. In the classical theory $\overline{G}$ is the additive group of integers. Two central results in the classical theory are: (1) A non-deterministic SSP is purely non-deterministic if and only if its spectral measure is absolutely continuous, and (2) An SSP is non-deterministic if and only if its spectral density has summable logarithm. In the setting where $\overline{G}$ is an arbitrary discrete Abelian group the notion of a "past" semigroup of non-positive integers is introduced. With respect to a given "past" semigroup, generalized notions of non-determinacy and pure non-determinacy are then given. (1) An appropriate smoothness condition on the spectral measure is determined, characterizing those "non-deterministic" (in the generalized sense) SSPs which are in fact purely non-deterministic. (2) With respect to any given semigroup in a certain large class of "past" semigroups, and appropriate spectral log-summability condition is described, characterizing those SSPs which are "non-deterministic." (3) Other results analogous to further details of the classical theory are also obtained. A comparison and distinction are made between this work and a more group-theoretically oriented generalization of the classical theory. Dissert. Abstr.

N68-25606 Auburn Univ., Ala.
AN EXISTENCE THEOREM FOR THE BARDEEN–COOPER–SCHRIEFFER EQUATIONS
Frederick Alan Massey (Ph.D. Thesis) 1966 74 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-51

A variational method is used to prove the existence of non-trivial solutions for sufficiently small temperature to the Bardeen–Cooper–Schrieffer integral equations for a certain restricted class of kernels. A kernel belongs to the class if it is a Hilbert–Schmidt kernel, having only non-negative characteristic values, and if the square root associated with the kernel possesses a function of its range at which a certain functional becomes negative. It is shown that the restricted class of kernels contains certain separable kernels which have been used as approximations to the physically derived kernels for the BCS equations. Also contained in the class is a kernel possessing a characteristic constant greater than one and a corresponding characteristic constant function. It is shown that if the temperature exceeds the norm of the kernel, then the BCS equations have only the trivial solution. Dissert. Abstr.

N68-25616# Lockheed Missiles and Space Co., Palo Alto, Calif.
SCALING OF COEFFICIENTS IN SOME NUMERICAL METHODS OF DETERMINING THE ZEROES OF FUNCTIONS
G. G. Tsegelik [1967] 5 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 8, no. 1, 1968 p 165–169
CFSTI: HC $3.00/MF $0.65

For numerical determination of the zeroes of polynomials, power series, and Laurent series, a transformation of the functions from the circle and annulus of convergence is used where the summation extends over all permutations; and a modification of the Brodetskii–Smil method for computing coefficients is evolved. New sequences are actually evolved during the method presented, and a formula is included for evaluating the roots of these sequences. M.W.R.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N68-24417# Freie Univ., Berlin (West Germany). Institut fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 72, NO. 3: NEW DETERMINATION OF ANGSTROEM PYRGEOMETER CONSTANTS AND RESULTS OF NOCTURNAL RADIATION MEASUREMENTS IN COMPARISON WITH RADIOSONDE ASCENTS IN BERLIN (1959–1965) [METEOROLOGISCHE ABHANDLUNGEN. BAND 72, NO. 3: NEUBESTIMMUNG DER KONSTANTEN VON ANGSTROEMSCHEN PYRGEOMETERN UND ERGEBNISSE NAECHTLICHER AUSSTRAHLUNGSMESSUNGEN IM VERGLEICH MIT RADIOSONDENAUFSTIEGEN IN BERLIN (1959–1965)]
Bernhard Lindenbein 1967 120 p refs In GERMAN; ENGLISH summary
CFSTI: HC $3.00/MF $0.65

The methods for calibrating pyregeometers and results of earlier investigations are reviewed. Three pyrgeometers were calibrated in 112 series of experiments by laboratory measurements with a black body and by comparison with results obtained with an actinometer under a clear night sky. The resistance of the blackened Manganin strips of the pyrgeometers, surface angle ratio, absorption capacity of the radiation shield, and error reduction are discussed. The 52 series of measurements recorded during 24 nights with an actinometer are evaluated for radiation capacity of a horizontal area at ambient temperature and related to atmospheric water vapor content. A new, simple formula comprised of trigonometric functions only is given for calculating surface angle ratios, and the distribution of incident radiation energy over the different parts of the blackened receiving surface is calculated. K.W.

N68-24420# France. Direction de la Meteorologie National, Paris.
CLIMATOLOGY OF FRANCE: SELECTION OF STATISTICAL DATA [CLIMATOLOGIE DE LA FRANCE: SELECTION DE DONNEES STATISTIQUES]
M. Garnier 1967 294 p refs In FRENCH
(Rept.-50) CFSTI: HC $3.00/MF $0.65

Statistical data are tabulated to depict the weather of France at various points across the country during each of the months of the year. Data are taken from observations made between 1931 and 1960, although not all of the years are covered for each of the meteorological elements considered. Data are tabulated for periods of cloudiness and sunshine; and for temperature, precipitation, evaporation, humidity, wind, and atmospheric pressure. Comments are made on rigorous winters in France, beginning with the 763–764 winter; and for unusual summers going back to 1135. Transl. by M.W.R.

N68-24421# France. Direction de la Meteorologie National, Paris.
CLIMATOLOGY OF FRANCE: ELEMENTS OF DIURNAL VARIATION [CLIMATOLOGIE DE LA FRANCE: ELEMENTS DE LA VARIATION DIURNE]
M. Garnier 1966 147 p In FRENCH
(Rept.-51) CFSTI: HC $3.00/MF $0.65

Daily variations for principal meteorological elements in France are tabulated from data collected by weather stations throughout the country between 1951 and 1960. Values are given for three-hourly averages at the various stations for each day of the month for each of the following observations: cloudiness, temperature, water vapor pressure, relative humidity, wind speed, and atmospheric pressure. Transl. by M.W.R.

N68-24425# Dayton Univ., Ohio. Research Inst.
AN ANALYSIS OF THE AN/FPS-16 ROSE SYSTEM
Nicholas A. Engler, James K. Luers, and John W. McCloskey Nov. 1967 112 p refs
(Contract AF 19(628)-4796)
(UDRI-TR-67-140; AFCRL-67-0534; SR-2; AD-667203)

The ROSE system utilizes 30-gram, 40-inch ROSE balloons and the AN/FPS-16 radar to obtain a fine scale vertical profile of horizontal winds from the radar track of the balloon. In order to establish the reliability of a calculated wind profile, an analysis of the system and of its components was compiled. Two basic smoothing techniques for obtaining velocities from a noisy discrete time series were considered: averaging techniques and polynomial techniques. Criteria for determining the optimum smoothing technique for a given experiment were also determined. The types of error found in the track of an AN/FPS-16 radar were analyzed and the range resolver error and the radar bias were investigated. When a least squares linear technique was used to compute the wind field the wind errors were also calculated. Six, 40-inch ROSE balloons were modified in regard to the number of gores and the size of the pressure valve used. An evaluation of the modified balloons indicated that the 4-gore, 3/4-inch ROSE performed best. A final comparison was made between this modified ROSE and the JIMSPHERE. Author (TAB)

N68-24432*# Allied Research Associates, Inc., Concord, Mass.
INTERPRETATION OF BAROCLINIC SYSTEMS AND WIND FIELDS AS OBSERVED BY NIMBUS 2 MRIR Final Report, Jan. 1967–Feb. 1968
Greenbelt, Md. NASA. Goddard Space Flight Center Feb. 1968 145 p refs
(Contract NAS5-10334)
(NASA-CR-94688; Rept.-9G43-F) CFSTI: HC $3.00/MF $0.65
CSCL 04B

Detailed studies of the characteristics of the Nimbus II medium resolution infrared radiometer data have revealed several important operational applications. These include: (1) Identification through the Channel I(6.4-6. $9\mu H_2O$) areas of active descending motions in the upper troposphere and lower stratosphere which are frequently associated with jet streams and deepening upper tropospheric cyclones in both the extratropical and subtropical regions. (2) Identification through the conjoint use of both Cahnnel I(6.4-6. $9\mu H_2O$) and Channel 3(14-16 CO_2) data of intense jet stream locations in the extratropics. (3) Delineation of cirrus cloud areas not readily observed in either the television or atmospheric "window" (10–11 μ) data. Secondary findings reported on include: (1) the use of multichannel color presentations to assist in clear area delineation, locating cirrus blow-off from large cumulonimbus conglomerates and synoptic scale storm systems; and (2) a potential application of the 6.4-6. 9μ H_2O data to delineation of areas of clear air turbulence, CAT. Author

N68-24532# Joint Publications Research Service, Washington, D. C.
METEOROLOGY
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 180 22 May 1968 p 9–57 refs (See N68-24530 14-13)

Meteorological news and abstracts of scientific articles dealing with meteorology are taken from the Soviet-bloc literature. News items deal with a conference on Arctic climate, an aeroclimatic handbook for Antarctica, isotopic electric power sources for radiometeorological stations, and hail. Climatology of Europe, parts of Asia, and the Soviet Arctic are covered, including cloud physics, wind profiles, and daily variations of these and other weather elements. Methods for studying the atmosphere and the ocean, sonic waves and absorption in the atmosphere, and various forms of turbulence are considered. Other abstracts deal with fog, temperature, mountain lee waves, solar radiation observations, and agriculture-related research. Prediction of ice cover, radiation flux into the lower atmosphere, and dust storms are also covered. M.W.R.

N68-24638# Japan Meteorological Agency, Tokyo.
AEROLOGICAL DATA OF JAPAN. IQSY (1964–1965) UPPER AIR DATA OF DEW-POINT TEMPERATURE, ATMOSPHERIC ELECTRICITY, LONG WAVE RADIATION
1967 239 p refs
CFSTI: HC $3.00/MF $0.65

Tabulated data obtained by upper atmosphere radiosonde measurements at the stations Sapporo, Tateno, Hachijojima, and Kagoshima are presented. This volume contains 362 water vapor readings, 216 atmospheric electricity readings, and 110 readings of long wave radiation fluxes. Construction and operation of the specially designed radiosondes are also described. K.W.

N68-25000# San Jose State Coll., Calif.
SUMMERTIME MARINE AIR PENETRATIONS TO THE CITY OF SACRAMENTO
Stephen John Savage (M.S. Thesis) Aug. 1967 100 p refs
(AD-667387)

The document covers the extent, characteristics, and significance of summertime sea air entry into the coastal area around Sacramento, California. TAB

N68-25027*# Chicago Univ., Ill. Satellite and Mesometeorology Research Project.
AERIAL MEASUREMENT OF RADIATION TEMPERATURES OVER MT. FUJI AND TOKYO AREAS AND THEIR APPLICATION TO THE DETERMINATION OF GROUND AND WATER SURFACE TEMPERATURES
Tetsuya Fujita, Gisela Baralt, and Kiyoshi Tsuchiya (Japan Meteorol. Agency) Mar. 1968 33 p refs
(Grants NsG-333, CWB-WBG-34; NSF GF-255; JSPS GEO-19)
(NASA-CR-94756; SMRP-RP-72) CFSTI: HC $3.00/MF $0.65
CSCL 04B

A portable radiometer with a spectral response in the 8-14 micron range was used to determine the equivalent blackbody temperature of (1) the slope of Mt. Fuji, (2) Sagami Bay, and (3) the city of Tokyo. A twin-engine aircraft was used to fly over these areas at various altitudes up to 12,000 ft. Through mapping the slope temperatures of Mt. Fuji, it was learned that the rocky slope heats up under the morning sun very rapidly to 32°C almost irrespective of the elevation. The distribution of measured temperatures explains the reasons for the rapid growth of cumulus clouds along the east slope in the early morning hours. The nadir-angle and the height dependence of equivalent blackbody temperatures measured over Tokyo and Sagami Bay were examined. The measured temperatures were compared with those computed from the radiative transfer equation. It was found that the values over Tokyo are reproduced fairly well by the addition of a graybody smog filling the layers up to 910 mb. To express the effects of atmospheric radiation upon the reduction of the radiant emittance from the surface, a damping factor was introduced. Author

N68-25041# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Munich (West Germany). Institut fuer Physik der Atmosphaere.
QUANTITATIVE ANALYSIS OF THE REFLECTIVITY OF RADAR WITH RESPECT TO PRECIPITATION INTENSITY [QUANTITATIVE UNTERSUCHUNGEN DER RADARREFLEKTIVITAET IN BEZUNG AUF DIE NIEDERSCHLAGSINTENSITAET]
H. Karstensen Mar. 1968 83 p refs *In* GERMAN; ENGLISH summary
(DLR-FB-68-20; DVL-715) CFSTI: $3.00/MF $0.65

Areas of precipitation were studied during two summers within a range of 50 nautical miles of Munich, Germany, using a 3.2-cm radar set Rmt 200-1c. The equipment is described. An example is given for obtaining echo strength by photometric evaluation of precipitation patterns of the polar coordinate representation of horizontal cross sections of the studied areas.

Taking into account evaporation, extinction, and simultaneously recorded intensity of precipitation, the relation between the echo strength and precipitation intensity was found to correspond closely in theory and experiments. Based on this relation, the precipitation areas are classified in six groups. The interdependence of height, cross sectional area, yield, and precipitation intensity in these groups are analyzed. K.W.

N68-25077 Florida State Univ., Tallahassee.
AN INVESTIGATION OF THE EFFECT OF SYNOPTIC-ANALYSIS ERRORS ON PREDICTIONS MADE WITH THE BAROTROPIC VORTICITY EQUATION WRITTEN IN SPECTRAL FORM
Dorathy Anne Stewart (Ph.D. Thesis) 1966 146 p Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-330

A theoretical method of determining minimum variances was applied to predictions made with the barotropic vorticity equation written in spectral form. The theory was first tested on hypothetical data, and then three synoptic cases were examined. Next, the effect of using past history to aid in in making analyses was considered, and theoretical expectations were compared with actual results for a five-day period. Finally, errors from spectral forecasts at station locations were compared with those from finite-difference forecasts for the same five-day period. Theoretically, one would expect errors to reach negligible proportions after a couple of days of past history have been used to aid in analysis. Apparently because of limitations in the physical model used, time continuity did not prove helpful during the five-day period tested. Forecast errors from the spectral technique were found to compare favorably with the corresponding errors from the finite-difference procedure. Dissert. Abstr.

N68-25127 Freie Univ., Berlin (West Germany). Inst. Fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 78, NO. 12: RESULTS OF SYNOPTIC SERVICE, DECEMBER 1967—DAILY WEATHER MAPS (SURFACE, 500 MB, 300 MB), TABLES AND SMALL SCIENTIFIC ESSAYS [METEOROLOGISCHE ABHANDLUNGEN. BAND 78, HEFT 12: ERGEBNISSE DES SYNOPTISCHEN DIENSTES IM JAHRE 1967—TAEGLISCHE WETTERKARTEN (BODEN, 500 MB, 300 MB), TABELLEN UND KLEINERE WISSENSCHAFTLICHE AUFSAETZE]
Richard Scherhag et al 1968 209 p refs *In* GERMAN
CFSTI: HC $3.00

This volume contains a report on monthly weather and temperature predictions during the winter in central Europe, a description of the central registration system for meteorological data at this institute, and an article on very long-term global integration of the primitive equations for atmospheric motion. Summaries, charts, and tables are presented on: (1) meteorology, climatology, and atmospheric radioactivity data for Berlin, Germany, during December 1967 as well as annual averages for that year; (2) the climatology of central Europe and the Northern Hemisphere for December 1967; (3) the world weather situation during December 1967; and (4) snow conditions in Germany during December 1967. This volume additionally contains daily weather charts for Germany, central Europe, and the Northern Hemisphere during December 1967. Transl. by K.W.

N68-25128 Freie Univ., Berlin (West Germany). Inst. Fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 78, No. 11: RESULTS OF SYNOPTIC SERVICE, NOVEMBER 1967—DAILY WEATHER MAPS (SURFACE, 500 MB, 300 MB), TABLES AND SMALL SCIENTIFIC ESSAYS [METEOROLOGISCHE ABHANDLUNGEN. BAND 78, HEFT 11: ERGEBNISSE DES SYNOPTISCHEN DIENSTES IM JAHRE 1967—TAEGLICHE WETTERKARTEN (BODEN, 500 MB, 300 MB), TABELLEN UND KLEINERE WISSENSCHAFTLICHE AUFSAETZE]
Richard Scherhag, et al 1968 211 p refs *In* GERMAN
CFSTI: HC $3.00

Presented in this volume are three articles on extreme weather conditions in Berlin, Germany, a discussion of a method for the spectroscopic determination of water vapor in an air column, and the results of a 10-year precipitation study in California, U.S.A. Several summaries, charts, and tables are presented on: (1) meteorology, climatology, and atmospheric radioactivity data for Berlin, Germany, during November and the autumn of 1967; and (2) climatology and weather data for Germany, central Europe, and the Northern Hemisphere during November, the autumn, and the entire year of 1967. In addition, the volume contains daily weather charts for Germany, central Europe, and the Northern Hemisphere during November 1967 as well as world weather reviews for November and the autumn of 1967. Transl. by K.W.

N68-25129 Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 80, NO. 2: DAILY ALTITUDE MAPS OF THE 100-MB-LEVEL AND THE 50-MB-LEVEL AS WELL AS MONTHLY MEAN MAPS, PART 2 [METEOROLOGISCHE ABHANDLUNGEN. BAND 30, HEFT 2: TAEGLICHE HOEHENKARTEN DER 100-MB-FLAECHE UND DER 50-MB-FLAECHE SOWIE MONATLICHE MITTELKARTEN FUER DAS JAHR 1967, TEIL 2. VIERTELJAHR] Quarterly Report, Apr.–Jun. 1967
Regina Kirch, Barbara Kriester, Karin Labitzke, Wolfgang Roeder, Richard Scherhag, et al 1968 219 p refs In GERMAN
(QR-2) CFSTI: HC $3.00

This volume contains the following meteorological information for the Northern Hemisphere during the period April 1 through June 30, 1967: (1) monthly mean, deviation, and change charts of the 100-mb and 50-mb levels; (2) tabulated profile values of monthly means for topographies, temperatures, and latitudes; (3) daily height charts of the 100-mb and 50-mb levels for the entire period; and (4) a review of the circulation in the lower stratosphere. Transl. by K.W.

N68-25130 Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 79, NO. 12: DAILY AND AVERAGE SURFACE MAPS AND 850-MB MAPS OF THE NORTHERN HEMISPHERE, DECEMBER 1967 [METEOROLOGISCHE ABHANDLUNGEN. BAND 79, HEFT 12: TAEGLICHE UND MITTLERE BODEN-KARTEN UND 850-MB-KARTEN DER NORDHEMISPHAERE IM JAHRE 1967, DEZEMBER]
Manfred Geb, Richard Scheraag, et al 1968 82 p refs *In* GERMAN
CFSTI: HC $3.00

In addition to a review of the world weather situation during December 1967, this volume contains the following meteorological information for the Northern Hemisphere for the same period: (1) charts showing monthly atmospheric pressures and deviations, temperatures and deviations, and precipitation; (2) daily 850-mb level charts; and (3) daily ground level charts. Transl. by K.W.

N68-25315 St. Louis Univ., Mo.
ENERGETICS OF SYNOPTIC-SCALE SYSTEMS
Fred Mathew Vukovich (Ph.D. Thesis) 1966 76 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-2974

A synoptic scale volume was considered as a volume which satisfies the following conditions: (1) it was bounded by latitude lines to the north and south, longitude lines to the east and west, and extended from the surface to the top of the atmosphere; and (2) its horizontal dimensions were large enough so that the average of the eddy deviation of any atmospheric parameter is approximately zero. The air in the volume was moist and vertical accelerations were allowed. For this volume, the expression which defined the available potential energy was derived, and the expression for kinetic energy was defined. The local time derivative of the available potential energy yielded terms which describe the generation of available potential energy, terms which describe the conversion between available potential energy and kinetic energy, and terms which describe the contribution due to advective effects. The available potential energy, the kinetic energy, and their respective time derivatives for the synoptic system were separated into their zonal and eddy contributions. Dissert. Abstr.

N68-25381 *# National Aeronautics and Space Administration, Flight Research Center, Edwards, Calif.

METEOROLOGICAL FEATURES OF HIGH ALTITUDE TURBULENCE ENCOUNTERED BY THE XB-70 AIRPLANE

L. J. Ehernberger May 1968 23 p refs Presented at AIAA 3rd Natl. Conf. on Aerospace Meteorology, New Orleans, 6–9 May 1968

(NASA-TM-X-61114) CFSTI: HC $3.00 CSCL 04B

Atmospheric turbulence encountered at altitudes above 40,000 feet by the XB-70 airplane during test flights over the Western United States is discussed in terms of the associated meteorological features. Rawinsonde data from stations nearest the regions of turbulence encounters have been examined for the wind velocity at the level of the maximum wind and at the 100-millibar level, for wind-shear layers below the encounter altitude, and for layers with pronounced wind shear, temperature lapse, or temperature inversion within 2000 feet of the turbulence-encounter altitude. A significant percentage of the higher intensity encounters were found to have maximum level and 100-millibar wind speeds exceeding 70 and 40 knots, respectively, shear layers below and near the turbulence altitude exceeding 0.020 and 0.005 per second, respectively, and temperature lapse or inversion layers exceeding 4.0 and 5.0 centigrade degrees per kilometer, respectively. Examples of ambient-temperature changes along the flight path, which were determined from the measured Mach number and total temperature, are presented for both turbulent and nonturbulent conditions. Author

N68-25442# France. Direction de la Meteorologie Nationale, Paris.

METHOD OF EVALUATING A HYDROLOGICAL BALANCE SHEET APPLICATION TO THE CEZE BASIN [METHODE D'EVALUATION D'UN BILAN HYDROLOGIQUE APPLICATION AU BASSIN DE LA CEZE]

A. Orieux, E. Pouget, A. Barbia, and H. Sabadel Aug. 1967 31 p refs In FRENCH

(Rept.-60) CFSTI: HC $3.00/MF $0.65

Hydrological balance sheets that were used at the Center for Meteorology at Marignane, France, were evaluated for application to the high river basin of the Cèze at Chambon. Details are included for two methods for the use of these balance sheets and for their graphical presentation. Null flow theory is discussed, and outputs are correlated with flow theory results. A direct evaluation was made of the transpiration evaporation potential, and annual balance sheets are included. The study indicated that the hydrological data could be used to give accurate estimates of the output of the river basin under consideration. Transl. by M.W.R.

N68-25466 *# RAND Corp., Santa Monica, Calif.

ON SATELLITE METEOROLOGY STUDIES Final Report

Y. H. Katz and R.E. Huschke May 1968 23 p refs

(Contract NASr-21(07))

(NASA-CR-94772; AR-384-NASA) CFSTI: HC $3.00/MF $0.65 CSCL 04B

Long time-series of both the heat loss and a zonal index were used to test the hypothesis that variations in the Arctic atmospheric radiative heat loss cause a predictable delayed response in the strength of zonal circulation. The data analysis shows fairly strong and very significant correlations (with heat loss) of the standard deviation and wave number anomalies at lags of −1 to −2 months. Summary information is presented on research pertaining to spherics detection from satellites, computer simulation of the heating characteristics of the Martian atmosphere, and distribution of constant-level balloons. M.G.J.

N68-25470# France. Direction de la Meteorologie Nationale, Paris.

THE WIND AT AN ALTITUDE FROM 30 TO 40 KM AT THE MAGNY LES HAMEAUX OBSERVATORY. DAILY DATA AND MONTHLY STATISTICS, 1964 [VENT EN ALTITUDE JOSQU'A 30 A 40 KM A L'OBSERVATOIRE DE MAGNY LES HAMEAUX DONNEES QUOTIDIENNES ET STATISTIQUES MENSUELLES, 1964]

G. D. Barbe, J. Boudigue, R. Darcel, J. Heissat, J. Lemieuvre et al Sep. 1966 29 p refs In FRENCH

(Rept.-56) CFSTI: HC $3.00/MF $0.65

Daily variations in wind speed and direction are tabulated for each month during 1964 based on observations of the region around Paris made at altitudes between 30 and 40 km. The daily sounding at the highest altitude attained is given, and, in general, soundings were made between 0900 and 1600 UT. Graphs picture the statistical results for each day during the month.

Transl. by M.W.R.

N68-25493# France. Direction de la Meteorologie Nationale, Paris.

FREQUENCY OF CERTAIN METEOROLOGICAL CONDITIONS UNFAVORABLE FOR AERONAUTICS AT 39 AIRPORTS [FREQUENCES DE CERTAINES CONDITIONS METEOROLOGIQUES DEFAVORABLES POUR L'AERONAUTIQUE A 39 AERODROMES]

A. Tasson and R. Bubeck Oct. 1966 196 p In FRENCH

(Rept.-57) CFSTI: HC $3.00/MF $0.65

Occurrence of unfavorable flight conditions, specifically low clouds and poor visibility, are shown for 39 airports in France for each month of the year. Data were accumulated between 1948 and 1964, although the time periods covered by each of the observation stations do not cover the entire period. Four sets of data present the number of days for clouds with bases lower than 30 m and horizontal visibility of less than 400 m, 60 m clouds and 800 m visibility, 120 m and 2000 m, and 300 m and 3000 m, obtained by synoptic observations made every three hours. Not all of the airports are covered by each of the data sets, however; and tables indicate the occurrence of the clouds, poor visibility, or both of these conditions. Transl. by M.W.R.

N68-25494# France. Direction de la Meteorologie Nationale, Paris.

THE CLIMATE OF IRAN [CLIMATS DE L'IRAN]

Chafi Djavadi Aug. 1966 101 p refs In FRENCH

(Rept.-54) CFSTI: HC $3.00/MF $0.65

Atmospheric movements, temperatures and thermal zones, and atmospheric humidity are detailed for Iran as a result of a study to adapt the Koppen system for climatological classification to a very mountainous country such as Iran. Results indicated a correlation between the types of climates and the climatological

distribution that enable the presentation of meteorological data as well as data on the distribution of plant life. The system is considered simple because it uses only monthly and annual data on average temperature and precipitation. Details are included for both dry and humid climates in Iran, and numerous graphs and tables give observations from various meteorological stations throughout the country. Transl. by M.W.R.

N68-25593# National Weather Records Center, Asheville, N. C. World Data Center A: Meteorology.
METEOROLOGICAL ROCKET NETWORK FIRINGS, VOLUME 4, NO. 7 Data Report, Jul. 1967
1968 190 p ref
GPO: $3.00

Wind and temperature measurements from all available meteorological sounding rocket firings are presented, along with computed values for pressure, density, and speed of sound. Local radiosonde observations nearest the time of firing are included. Author

N68-25617*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOME METEOROLOGICAL OBSERVATIONS OF THE SOUTHERN HEMISPHERE STRATOSPHERE AND MESOSPHERE
J. S. Theon and J. J. Horvath (Mich. Univ., Ann Arbor) Washington Jun. 1968 12 p refs
(NASA-TN-D-4264) CFSTI: HC $3.00/MF $0.65 CSCL 04B

A sea-going experiment was carried out in 1965 to obtain rocket sounding measurements from the atmosphere of the Southern Hemisphere along the west coast of South America from the equator to 60°S. Results are presented for eight Nike Apache pitot-type tube experiments, which were among the 77 rocket soundings taken. Temperature structures in the Southern Hemisphere stratosphere and mesosphere were somewhat different from their Northern Hemisphere counterparts during the corresponding season; and, especially at temperate latitudes, the Southern Hemisphere upper atmosphere was characterized by a warmer stratopause and a colder mesopause. The geostrophic approximation provided a reasonably accurate means for obtaining winds up to 70 km altitude, and zonal wind patterns in this region were characterized by an easterly core centered at 30 to 35 km above the tropics as well as westerly flow that increased with latitude and altitude to a maximum of 60 km above 60°S. This circulation was associated with the developing winter polar vortex. M.W.R.

N68-25634 Instituto y Observatorio Astronomico de Marina, San Fernando (Spain).
ANNALS OF MARINA INSTITUTE AND OBSERVATORY. SECTION 3A: METEOROLOGICAL AND MAGNETIC OBSERVATIONS FOR 1963 AND 1964 [ANALES DEL INSTITUTO Y OBSERVATORIO DE MARINA. SECCION 3A: OBSERVACIONES METEOROLOGICAS Y MAGNETICAS ANOS 1963–1964]
F. Fernandez de la Puente 1967 77 p In SPANISH

This annal contains the tabulated results of meteorological and magnetic observations made by the Marina Institute and Observatory during 1963 and 1964. The meteorological data include barometric pressure, temperature, water vapor tension, relative humidity, wind direction and velocity, cloud cover, monthly and yearly summaries of weather conditions, and a general summary of meteorological data from 1870 to 1964. The magnetic data include absolute observations of declination, inclination, and horizontal force, a general summary of mean annual values of magnetic elements from 1891 to 1964, mean annual values of declination and horizontal force, indices of magnetic activity, and diurnal variations of the declination and horizontal force.
Transl. by R.N.A.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N68-24409*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STABILITY ANALYSIS AND MINIMUM THRUST VECTOR CONTROL REQUIREMENTS OF BOOSTER VEHICLES DURING ATMOSPHERIC FLIGHT
Janos Borsody and Fred Teren Washington May 1968 44 p ref
(NASA-TN-D-4593) CFSTI: HC $3.00/MF $0.65 CSCL 17G

Generalized analytic results are derived to give a complete description of an open-loop minimal control requirement to maintain stability for a rigid-body vehicle configuration. The results are easily applicable to both pitch and yaw control planes at any flight time of interest by computing some vehicle dependent parameters and evaluating the given equations. The results show that, with good control system design, the deflection requirements can be reduced to about 56 percent of trim deflection. At the same time, because of the method of control, the maximum angle of attack and bending moments can also be substantially reduced. Author

N68-24512*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field.
A HAND-HELD SEXTANT QUALIFIED FOR SPACE FLIGHT
Bedford A. Lampkin and Donald W. Smith Washington May 1968 31 p refs
(NASA-TN-D-4585) CFSTI: HC $3.00/MF $0.65 CSCL 17G

A hand-held sextant has been developed and fabricated for use in space navigation. The instrument is space-flight rated. Experienced operators may obtain measurement data having an accuracy of better than 10 seconds of arc. The mechanical, optical, and electrical characteristics of the instrument are described in detail. A synopsis of the results of the environmental tests to which the instrument was subjected and a mechanical error model of the instrument are presented. Measurement data and analysis are presented which indicate the operational accuracy of the sextant. Author

N68-24555*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STAR TRACKER CALIBRATION
Lawrence T. Draper Washington Jun. 1968 13 p refs
(NASA-TN-D-4594) CFSTI: HC $3.00/MF $0.65 CSCL 17G

Optical star tracker calibrations varied among companies in the industry by as much as 250 percent. A calibration procedure has been developed which relates a standard of spectral irradiance to real stars by laboratory measurements and computations. Initial results from trackers calibrated for the Aerobee Sounding Rocket Program indicate a calibration accuracy on the order of 15 percent. Author

N68-24636# Arbeits- und Forschungsgemeinschaft Graf Zeppelin, Stuttgart (West Germany).
MEASUREMENT OF ROTATIONAL VELOCITY AND ROTATIONAL DIRECTION IN NAVIGATION BY VIBRATORY SYSTEMS [DIE MESSUNG VON DREHGESCHWINDIGKEITEN UND DREHRICHTUNGEN IN DER NAVIGATION DURCH SCHWINGENDE SYSTEME]
A. Karolus (Zollikon, Zuerich) 30 May 1967 30 p refs In GERMAN Presented at Aeron. Conf., Stuttgart, 30 May 1967
(Rept.-74) CFSTI: HC $3.00/MF $0.65

Experimental results are discussed which were obtained in the designing and constructing of tuning fork gyrotron systems. The emphasis is on factors affecting stability, service life, effective signal, and signal interferences in such systems. Requirements of the torsional system and of the electrostatic or magnetic drives are briefly pointed out, and vibratory systems are compared with rotating wheel gyroscopes. The effects of gravity, temperature, mechanical precision, acceleration, symmetry, vehicular motion, and the Coriolis effect on accuracy are examined. Transl. by K.W.

N68-24709*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.

ANALYSIS OF SPACE STABILIZED INERTIAL NAVIGATION SYSTEMS

Kenneth R. Britting Jan. 1968 81 p refs

(Grant NGR-22-009-229)

(NASA-CR-94735; RE-35) CFSTI: HC $3.00/MF $0.65 CSCL 17G

This report is a tutorial exposition of the class of inertial navigation systems which instrument an inertially nonrotating coordinate frame. A detailed discussion of the possible types of system mechanizations is followed by a discussion and error analysis of self-contained alignment schemes. Stabilization of the vertical error is investigated. Perturbation methods are used to derive linear error equations which apply to a high performance vehicle such as the Supersonic Transport. The error sources treated consist of: (1) altimeter uncertainty, (2) deflection of the vertical, (3) accelerometer uncertainty and scale factor error, (4) gyro drift, (5) initial misalignment error, and (6) initial condition errors. The error equations are solved for the case of constant gyro drift and altimeter uncertainty. Author

N68-25103*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ON BOARD CALCULATIONS OF A TWO IMPULSE ABORT TO A PRESELECTED LANDING SITE

Robert B. Merrick Washington May 1968 27 p refs

(NASA-TN-D-4599) CFSTI: HC $3.00/MF $0.65 CSCL 22C

A two impulse maneuver allows great flexibility in the choice of a landing site. This paper assumes that a nominal two impulse abort trajectory has been selected before flight but that the velocity required to attain that abort trajectory from off nominal conditions will be computed manually on board the spacecraft. The method presented here accomplishes the entire plane change with the first impulse and restricts the application of this impulse to cetain preselected ranges. The basic theory is valid for any transfer, in either planocentric or heliocentric space, between two positions whose inertial coordinates are known at prescribed times. Consequently, the theory would allow the method to be used for computing aborts from inbound trajectories, but reasonable fuel limitations restrict its primary applicability to outbound trajectories. The computational procedure developed obtains three orthogonal components, in inertial axes, of the velocity to be gained for the first impulsive rocket firing and obtains the magnitude of second impulse. It is shown that the method is feasible for manual calculations, using four figure accuracy, with a family of graphs to match the time constraint. Author

N68-25557*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SIMPLIFIED PROCESSING OF STAR TRACKER COMMANDS FOR SATELLITE ATTITUDE CONTROL

R. D. Showman [1967] 7 p refs Presented at the Session on Systems Simulation at the IEEE Intern. Conv., 20–23 Mar. 1967

(NASA-TM-X-59724) CFSTI: HC $3.00/MF $0.65 CSCL 17G

A method for using gimbaled star trackers to obtain useful attitude control signals is presented. Gimbaled trackers are required if the spacecraft is to be pointed in an arbitrary direction and if any suitable star is to be chosen as a guide star for the star tracker. With the trackers locked on to their guide stars, deviation of the gimbals from their commanded angles provides a measure of the error in vehicle attitude. Since the errors are generated about axes which are not necessarily mutually orthogonal nor alined with the spacecraft's control axes, they must be processed somehow to make them useful as control signals. The study considered here develops a realizable approximation of the nonlinear processor required to generate vehicle attitude errors from the gimbal angle error measurements. The approximate processor is simple enough for use on board current spacecraft and allows satisfactory performance over as wide a range of star tracker gimbal angles and satellite attitudes as desired. Author

N68-25637* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

COMMENTS ON A COOPERATIVE RF TECHNIQUE FOR COLLISION-HAZARD WARNING

James H. Schrader [1967] 10 p Presented at the Inst. of Navigation Natl. Air Meeting on Collision Avoidance, Dayton, Ohio, 23–24 Feb. 1967

(NASA-TM-X-59606) CFSTI: $3.00 CSCL 17G

The initiation of a study designed to investigate the feasibility of a relatively simple, cooperative, radio frequency warning system is reported. The proposed system utilizes a transponder designed to reply to interrogating aircraft with a cw signal containing a true doppler term. This doppler term is used in conjunction with the basic range limitation imposed by transmitter power to help discriminate between hazardous and non hazardous intruding aircraft. Discussed briefly are efforts related to preliminary studies of systems problems, and experimental studies on antenna and transponder design problems. On the basis of preliminary studies, it is concluded that a system can be developed where the basic installation consists of a relatively simple transponder capable of replying to a number of aircraft simultaneously, and where the degree of protection provided to an individual aircraft is primarily a function of the equipment contained in the protected aircraft. S.C.W.

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N68-24372 Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.

POST IRRADIATION EXAMINATION OF THORIA-URANIA FUEL RODS Quarterly Progress Report, Mar.–Aug. 1967

W. N. Bishop, S. F. Marsh, and C. J. Baroch Jan. 1968 34 p refs

(Contract AT(30-1)-3809)

(BAW-3809-1; QPR-1) CFSTI: HC $3.00/MF $0.65

Thirteen fuel rods composed of ThO_2–UO_2 mixtures contained in six fuel elements were selected for post irradiation examination. Eleven of these rods have been removed from four of the elements. A rapid sequential chemical separation procedure for uranium, plutonium, americium-curium, cesium, neodymium, promethium, and samarium has been adapted from a separation procedure used for burnup analysis of uranium fuels. Author (NSA)

N68-24418# Eidgenoessiches Institut fuer Reaktorforschung, Wurenlingen (Switzerland).
SOS-1: A PROGRAM FOR CALCULATING THE FLUX IN HETEROGENEOUS SYSTEMS
G. Burnand Aug. 1967 25 p refs
(EIR-126)

The computer program SOS-1 for calculating the flux in heterogeneous critical or subcritical systems is described. The moderator flux is obtained from diffusion theory; three energy groups are used. The flux is expanded into a Fourier series around the surface of each element, and boundary conditions at channel surfaces are specified in terms of absorption and production coefficients. Extrapolated radii of the system are allowed to vary from group to group. NSA

N68-24428# Instituto de Energia Atomica, Sao Paulo (Brazil). Divisao de Engenharia Nuclear.
DETERMINATION OF THE MASS OF URANIUM OXIDE IN THE SUB-CRITICAL ASSEMBLY RESSUCO [CALCULO DA MASSA DE OXIDO DE URANIO PARA O ARRANJO SUB-CRITICO RESSUCO]
H. R. Franzen, Mioco Foshina, and Elenice Mazzilli Dec. 1966 23 p refs In PORTUGUESE, ENGLISH summary
(IEA-130) CFSTI: HC $3.00/MF $0.65

Formulas are presented for obtaining the mass of uranium oxide in the sub-critical assembly Ressuco moderated with light water. The choice of each fundamental expression was made according to a numerical test based on the characteristics of the lattice arrangements of uranium oxide whose cladding was of aluminum of steel. A IBM 360, Model II, computer was used in all the calculations for the determination of the mass of fuel for the sub-critical, Ressuco. Author

N68-24429# Forsvarets Forskningsanstalt, Stockholm (Sweden).
ANALYSIS OF MECHANICAL DAMAGES AT NUCLEAR EXCURSIONS [ANALYS AV MEKANISK SKADEVERKAN VID EN NUKLEAER EXKURSION]
C. A. Askloef and A. Persson Sep. 1967 27 p refs In SWEDISH
(FOA-2-A-2498-44)

An analysis is made of the mechanical damages by a nuclear excursion in a fast steam-cooled reactor. The probability of penetration of the reactor tank by fragments is judged to be low. The radial expansion direction of the reactor core resists twice as much released energy as the axial direction. The damages in the axial direction depend on the release of kinetic energy and are estimated to be: Less than 800 MJ—no deformation of the reactor tank; 800–1700 MJ—local penetrations in bottom and cover, ejections may occur; 1700–3000 MJ—great hazard of ejections at speeds of 60 m per sec; more than 3000 MJ—bottom and tank may be demolished and the tank moved. Author (NSA)

N68-24437# Instituto de Energia Atomica, Sao Paulo (Brazil).
ON THE EVALUATION OF CROSS SECTION MACROSCOPIC SHOCK OF SEMIMODERATOR ABSORTION BY THE IMPULSE METHOD [SOBRE A DETERMINACAO DA SECAO DE CHOQUE MACROSCOPICA DE ABSORCAO DE MEIOS MODERADORES NO METODO DE FONTE PULSADA]
H. R. Franzen Nov. 1966 11 p refs In PORTUGUESE; ENGLISH summary
(IEA-129) CFSTI: HC $3.00/MF $0.65

The report outlines a method to evaluate the moderator absorption cross section investigated by impulse method. The water and graphite absorption cross sections were obtained by taking into account the transport mean free paths already calculated and the decay constants for different moderator heights. Author

N68-24450# Aktiebolaget Atomenergi, Stockholm (Sweden).
TRANSIENT TEMPERATURE DISTRIBUTION IN A REACTOR CORE WITH CYLINDRICAL FUEL RODS AND COMPRESSIBLE COOLANT
Heinz Vollmer 1967 38 p refs
(AE-315)

Applying linearisation and Laplace transformation the transient temperature distribution and weighted temperatures in fuel, canning and coolant are calculated analytically in two-dimensional cylindrical geometry for constant material properties in fuel and canning. The model to be presented includes previous models as special cases and has the following novel features: compressibility of the coolant is accounted for. The material properties of the coolant are variable. All quantities determining the temperature field are taken into account. It is shown that the solution for fuel and canning temperature may be given by the aid of 4 basic transfer functions depending on only two variables. These functions are calculated for all relevant rod geometries and material constants. The integrals involved in transfer functions determining coolant temperatures are solved for the most part generally by application of coordinate and Laplace transformation. Author

N68-24469# European Atomic Energy Community, Ispra (Italy).
THESEE I: CODE FOR CALCULATING PERFORMANCES OF AN ORGEL REACTOR CHANNEL [THESEE I. CODE DE CALCUL DES PERFORMANCES D'UN CANAL DE REACTEUR DE TYPE ORGEL]
B. Chambaud, P. Civardi, G. di Cola, and R. di Cola Mar. 1968 108 p refs In ITALIAN; ENGLISH summary
(EUR-3905.f) CFSTI: $3.00

The code THESEE-1, programmed in FORTRAN IV for the IBM 360 computer, allows the determination of: (1) the organic coolant temperature distribution of a cluster fuel element; (2) the cladding temperature distribution around the most charged fuel rod; and (3) the average thermohydraulic performances of the channel of an ORGEL type reactor. Author

N68-24500# Institutt for Atomenergi, Halden (Norway).
EVALUATION OF THE IRRADIATION DAMAGE IN THE HBWR PRESSURE VESSEL MATERIALS
Amund Hanevik and Ketil Videm Nov. 1967 37 p refs
(HPR-91)

The irradiation induced changes in impact properties of the mild steel components in the Halden Boiling Water Reactor (HBWR) pressure vessel have been investigated by irradiation of Charpy V-notch specimens both at ORNL and in the HBWR. The results indicate that the compound plate in the vessel wall is more irradiation sensitive than the flange, lid or weld materials. The neutron spectrum in the HBWR has been calculated by three different computer codes. For specimens irradiated near the vessel wall better correlations between neutron dose and damage is found by use of a multigroup treatment rather than by a simple square root law which takes into consideration only neutrons with energies above 1 MeV. Assessment of the transition temperatures in the vessel itself after the second and third charge operations of the reactor is based on the established correlations. Safety against brittle fracture is at present secured by keeping the vessel above Nil Ductility Temperature (NDT) + 60°F during shutdown conditions because of unknown residual stresses. These stresses have been assessed for the cylindrical part of the vessel, which has the highest transition temperature and is thus the determining factor. This assessment indicates that the stress level is about 8 kg/mm^2 in the unpressurized condition, or about 25% of the room temperature yield strength. This forms the basis for a suggested change in the brittle fracture hazard's criterion to Crack Arrest Temperature (CAT) + 10°C. Author (NSA)

N68-24509# California Univ., Livermore. Lawrence Radiation Lab.
REACTOR CALORIMETRY [REAKTOROVA KALORIMETRIE]
J. Kott and Z. Kovar Dec. 1966 34 p refs Transl. into ENGLISH from Jaderna Energie (Prague), v. 12, no. 8, 1966 p 289-296
(UCRL-TRANS-10217) CFSTI: HC $3.00/MF $0.65

A brief description of the mechanism of radiation damage and heating of construction materials in a reactor radiation field, the importance of these effects from the point of view of reactor operation, and recent possibilities of the application of computers in determining the amount of energy absorbed in materials are given. The calorimetric methods of reactor dosimetry were conveniently classified and fundamental physical formulas for individual calorimetric arrangements and various measurement methods were established. The different design modifications of reactor calorimeters and respective measurement methods used recently are reviewed. A classification of calorimetric measurements is discussed together with the evaluation of results with respect to measurement categories. Author (NSA)

N68-24514# Instituto de Energia Atomica, Sao Paulo (Brazil).
PROGRESSIVE SUBSTITUTION EXPERIMENTS IN UO SUB 2 LATTICES MODERATED BY D SUB 2 O/H SUB 2 O MIXTURES
H. R. Franzen Apr. 1967 31 p refs
(IEA-139) CFSTI: HC $3.00/MF $0.65

Buckling measurements for cores of uranium oxide (3.00 % enriched in U^{235}) in different mixtures of D_2O/H_2O were performed in the NORA reactor by means of a progressive substitution technique. In order to check the results, some experiments were also carried out by the substitution technique in critical lattices for which the buckling was already known. Some subcritical experiments were also performed to give additional information about the buckling obtained by substitution experiments. The analysis was done by three regions, two group theory and a correction was introduced in order to take into account the effect of the reflector. For a D_2O concentration of 99.50% and a lattice pitch of 6.544 cm, the material buckling with void was obtained by three regions, one group theory. Author

N68-24522*# Techtran Corp., Glen Burnie, Md.
DETERMINATION OF NEUTRON SPECTRA IN A COUPLED GRAPHITE-HEAVY WATER REACTOR [CONSIDERAZIONI SULL'ADATTAMENTO DEGLI SPETTRI NEUTRONICI IN UN REATTORE ACCOPPIATO GRAFITE-D SUB 2 O]
F. Casali Washington NASA May 1968 14 p refs Transl. into ENGLISH of Comit. Naz. Energia Nucl., Rome, Rept. RT/FI(66)38
(Contract NASw-1695)
(NASA-TT-F-11706) CFSTI: HC $3.00/MF $0.65 CSCL 18K

The author analyzes on the basis of two-group theory the effect on K of indeterminateness of the spectrum in the case of measurements made with the reactor RB1 under certain conditions. He concluded that when charged with 7 to 13 fuel elements and used under the specified conditions the reactor RBI exhibits the characteristics of an infinite reactor and that determination of the spectrum is of no great importance, but that efforts should be made to produce or obtain suitable structural materials to delimit the zone under examination. Author

N68-24559*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
REACTIVITY CONTROL OF FAST-SPECTRUM REACTORS BY REVERSIBLE HYDRIDING OF YTTRIUM ZONES
John L. Anderson, Wendell Mayo, and Edward Lantz Washington Jun. 1968 35 p refs
(NASA-TN-D-4615) CFSTI: HC $3.00/MF $0.65 CSCL 18D

The temperature dependent equilibrium hydrogen content of yttrium hydride above 1173°K is investigated as a means of reactivity control for a cylindrical reactor using zones of hydride in various in core and reflector configurations. The temperature dependence is such that the control system is inherently self-regulating. Severe power peaking, dependent on the hydrogen density, occurs at the hydride core interfaces. Use of auxiliary control for startup reduces the control demand on the variable hydriding system and thus reduces the power peaking. A configuration for which the reactivity control satisfies required core life and power peaking limits is presented. Author

N68-24564# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
EXPERIMENTAL BERYLLIUM OXIDE REACTOR PROGRAM Quarterly Progress Report, 30 Sep.-31 Dec. 1966
8 Feb. 1967 47 p refs
(Contract AT(04-3)-187)
(GA-7485) CFSTI: HC $3.00/MF $0.65

Beryllium Oxide Reactor Experiment: operation description during September to December 1966, description of; cooling system for, description of; Reactor Fuel Elements: description of EBOR; Reactor Control Elements: drive mechanism for EBOR, description of; Beryllium Oxide Reactor Experiment: control rods for, description of program for straightening; physics calculations for, description of; Reactor Safety: leak hazard in EBOR, analysis of main loop oil; Criticality Studies: physics calculations for EBOR, description of; Beryllium Oxide Reactor Experiment: maintenance description during September to December 1966; Remote-Handling Equipment: description of EBOR; Lubricants: leaks of EBOR main loop oil, analysis of hazards of. NSA

N68-24570# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
EXPERIMENTAL STUDY OF THE NEUTRON THERMALISATION PROCESS IN TIME IN GRAPHITE AND BERYLLIUM
V. I. Mostovoi, A. A. Chernyshov, M. S. Yudkevich, I. P. Sadikov, S. N. Ishmatev et al May 1967 24 p refs Transl. into ENGLISH from I.A.E.A. Rept. SM-62/108
(AERE-TRANS-1084; IAEA-SM-62/108) HMSO: 2s 6d

A description is given of an experimental installation for studying the establishment of an equilibrium neutron energy spectrum in various media. Short pulses of fast neutrons were produced in the moderators under study by means of a high-current linear electron accelerator. At various intervals following the production of the fast-neutron pulse, the neutron spectra in the beam extracted from the moderator were measured by means of a mechanical chopper phased to the operation of the accelerator. The optimum resolution in spectrum measurement was 2.5 2.5 μs/m and the minimum uncertainty in the measurement of slowing-down time was 3.5 μs. Results are given for the measurement of non-stationary spectra in graphite and in beryllium for slowing-down times of between 30 and about 2500 μs. The results measured in beryllium are compared with calculations of non-stationary spectra made with the aid of double-differential cross-sections computed on the basis of experimental data on the energy spectrum of Be lattice vibrations. Author

N68-24582# Aktiebolaget Atomenergie, Stockholm (Sweden).
ACTIVATION DOPPLER MEASUREMENTS ON U 238 AND U 235 IN SOME FAST REACTOR SPECTRA
L. I. Tiren and I. Gustafsson Mar. 1968 41 p refs
(AE-314)

Measurements of the Doppler effect in U238 capture and U235 fission have been made by means of the activation technique in three different neutron spectra in the fast critical assembly FRO. The experiments involved the irradiation of thin uranium metal foils

or oxide disks, which were heated in a small oven located at the core centre. The measurements on U238 were extended to 1780°K and on U235 to 1470°K. A core region surrounding the oven was homogenized in order to facilitate the interpretation of results. The reaction rates in the uranium samples were detected by gamma counting. The data obtained for U238 capture were corrected for the effect of neutron collisions in the oven wall, and were extrapolated to zero sample thickness. An appreciable Doppler effect in U235 fission was obtained only in the softest spectrum, in which the measured increase in fission rate on heating from 320 to 1470°K was 0.007 ±0.003. Author

N68-24590# California Univ., Livermore. Lawrence Radiation Lab.

GEISHA-II: A CDC 6600 CODE FOR USE IN PARAMETRIC SPACE SHIELDING SURVEYS

T. P. Wilcox 7 Sep. 1966 43 p refs

(Contract W-7405-ENG-48)

(UCID-15284) CFSTI: HC$3.00/MF$0.65

Geisha-II is a point kernel shielding code written to perform parametric surveys that will be useful in designing the shield and reactor of space power systems. The code is able to vary the core's, and consequently the reactor system's, size by using neutronic constraints. If desired, the code will also vary the shield's thickness to obtain a given dose rate at the payload. It will also vary the shield's position to insure that the maximum shield temperature is below a given value. Secondary gamma production is included as well as are core fast neutrons and six energy groups of gammas. Both component and system total weights are indicated in the final output. The main calculations of the code are; (1) the size of the core; (2) the neutron flux at the payload; (3) the core gamma flux at the payload; (4) the secondary gamma flux at the payload; and (5) the shield heating rate and maximum temperature. Re-cycling is done to vary the shield thickness and position if this is desired. The neutron calculation makes use of the standard removal theory. The gamma calculations use similar theory with buildup factors. Six gamma groups are used to account for spectral changes occurring in thick shields. NSA

N68-24599# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

EFFECTS OF UNCERTAINTIES IN NUCLEAR DATA ON EXPERIMENTAL AND CALCULATED REACTOR BURNUP

D. E. Christensen, R. C. Liikala, R. P. Matsen, and D. L. Prezbindowski 26 Feb. 1968 12 p refs Presented at 2d Conf. on Neutron Cross Sect. and Technol., Washington, D. C.

(Contract AT(45-1)-1830)

(BNWL-SA-1485; CONF-680307-4) CFSTI: HC$3.00/MF$0.65

Inaccuracies in the basic nuclear data information result in uncertainties in the experimental determination and the theoretical prediction of reactor burnup. The experimental determination of reactor burnup requires measuring the number of fissions that occur and the changes in the fuel isotopic composition as a function of exposure. These data are also utilized to deduce ratios of effective cross sections. A fundamental quantity required in the determination is the content of a fission monitor (e.g., ^{137}Cs, ^{148}Nd, etc.). Uncertainties in yield, half lives, and branching ratios of the monitor lead to uncertainties in the number of fissions. This results in uncertainties in determining the isotopic composition of the fuel and the ratios of effective cross sections as a function of exposure. The measured isotopic composition changes along with the deduced ratios of effective cross sections are used to compare to theoretically predicted values to check the accuracy of the theoretical methods. The theoretical prediction of reactor burnup is based upon the use of cross sections. Uncertainties in the basic cross sections lead to uncertainties in calculated results. Results are given for plutonium fuel (Al–Pu) irradiation experiments conducted in the Plutonium Recycle Test Reactor (PRTR). Author (NSA)

N68-24602# Joint Publications Research Service, Washington, D. C.

SOVIET ATOMIC SCIENCE AND ENGINEERING

K. I. Shchelkin 13 May 1968 513 p refs Transl. into ENGLISH of the publ. "Sovetskaya Atomnaya Nauka i Tekhnika" Moscow, Atom Energy Publishing House, 1967 p 1–392

(JPRS-45331) CFSTI: HC$3.00/MF$0.65

CONTENTS:

1. INTRODUCTION p 1–14

2. THE FIRST SOVIET ATOMIC REACTORS I. S. Panasyuk p 16–53

3. RESEARCH REACTORS V. V. Goncharov p 54–97

4. PHYSICAL INVESTIGATIONS OF NUCLEAR REACTORS S. M. Feynberg, B. S. Pozdnyakov, and Ye. A. Koptelov p 98–115

5. ATOMIC ELECTRIC POWER STATIONS B. B. Baturov and Yu. I. Koryakin p 116–160

6. THE ATOMIC ICEBREAKER LENIN N. M. Mordivinov, B. G. Pologikh, A. K. Sledzyuk, and N. S. Khlopkin p 161–174

7. CHARGED PARTICLE ACCELERATORS A. A. Kolomenskiy, E. G. Komar, and S. M. Rubchinskiy p 176–195 (See N68-24603 14-11)

8. HIGH ENERGY PHYSICS A. M. Baldin, V. P. Dzhelepov, V. P. Zrelov, L. I. Lapidus, L. B. Okun et al p 196–236 (See N68-24604 14-24)

9. THE 70 BEV PROTON SYNCHROTRON Yu. Ado and E. M. Myae p 237–241 (See N68-24605 14-11)

10. THE HEAVY ION ACCELERATOR G. N. Vyalov p 242–251 (See N68-24606 14-11)

11. METHODS OF SYNTHESIS AND PROPERTIES OF THE TRANSURANIUM ELEMENTS G. N. Flerov and V. A. Druin p 252–269 (See N68-24607 14-24)

12. INVESTIGATIONS ON CONTROLLED THERMONUCLEAR REACTIONS IN THE USSR I. N. Golovin, B. B. Kadomtsev, and V. T. Tolok p 270–291 (See N68-24608 14-25)

13. THE TECHNOLOGY OF URANIUM ORE PROCESSING G. A. Kovda, B. N. Laskorin, and B. V. Nevskiy p 293–316

14. ATOMIC MATERIALS SCIENCE N. P. Agapova, A. A. Bochvar, A. S. Zaymovskiy, S. T. Konobeyevskiy, and V. I. Kutaytsev p 317–339 (See N68-24609 14-22)

15. RADIO CHEMISTRY V. M. Vdovenki, Z. V. Yershova, B. S. Kolychev, and V. V. Fomin p 340–361 (See N68-24610 14-06)

16. NUCLEAR INSTRUMENT BUILDING V. V. Matveyev, M. N. Pchelnikov, and B. I. Khazanov p 363–385 ref (See N68-24611 14-14)

17. ATOMIC ENERGY IN BIOLOGY AND MEDICINE V. V. Bochkarev, N. G. Darenskaya, V. M. Kozlov, A. N. Marey, R. V. Petrov et al p 386–417

18. USAGE OF NUCLEAR RADIATION IN AGRICULTURE A. M. Kuzin and N. M. Berezina p 418–424

19. RADIATION ENGINEERING G. I. Kir'yanov, I. I. Kreyndlin, N. I. Leschinskiy, S. V. Mamikonyan, V. B. Osipov et al p 425–454 refs (See N68-24612 14-24)

20. RADIATION SAFETY A. I. Burnazyan, V. M. Kozlov, V. D. Turovskiy, R. I. Karateyeva, A. I. Ryzhov et al p 456–484

21. INTERNATIONAL COOPERATION IN THE PEACEFUL USES OF ATOMIC ENERGY V. S. Yemel'yanov p 486–509

N68-24609# Joint Publications Research Service, Washington, D. C.

ATOMIC MATERIALS SCIENCE

N. P. Agapova, A. A. Bochvar, A. S. Zaymoyskiy, S. T. Konobeyevskiy, and V. I. Kutaytsev *In its* Soviet Atomic Sci. and Eng. 13 May 1968 p 317–339 (See N68-24602 14-22)

Tabulated data are presented to show which elements of the periodic table are being used or tested for use as the basis of possible materials for nuclear fuels and their envelopes; moderators; heat transfer agents; neutron absorbing materials;

radiation shields; sources of alpha, beta, gamma, and neutron radiation; construction materials, special installations for direct conversion of atomic energy to electric power, etc. The problems of atomic materials science are examined in terms of uranium and plutonium fuels; state diagrams of binary alloys of plutonium are included. The characteristics of specific alloys developed for reactors are defined, and the radiation effects on materials encountered during nuclear reactor operations are described. M.G.J.

N68-24620# Gulf General Atomic, San Diego, Calif.
FEASIBILITY STUDY OF AN ACCELERATOR-BOOSTER, FAST, PULSED RESEARCH REACTOR: NEUTRON YIELD STUDIES Final Report
D. E. Groce 30 Jun. 1967 60 p refs
(Contract AT(04-3)-167)
(GA-8087) CFSTI: HC $3.00/MF $0.65

The total yield of neutrons in accelerator-booster targets by high-energy electron bombardment is investigated as part of the feasibility of the use of an electron accelerator as a neutron source for a fast pulsed research reactor. Measurements of absolute neutron yields for ^{233}U, ^{235}U, ^{238}U, and ^{239}Pu targets of various thicknesses at several electron energies between 10 and 80 MeV are presented. NSA

N68-24717# Argonne National Lab., Ill.
EXPERIMENTAL STUDY OF NEUTRON CHARACTERISTICS IN FAST MULTIPLYING MEDIA USING THE THERMAL-FAST CRITICAL ASSEMBLY "ERMINE"
J. Bouchard, J. C. Mougniot, and R. Vidal 3 Nov. 1967 22 p refs Presented at Conf. on Fast Reactor Phys. and Related Safety Probl., Karlsruhe, Germany, 30 Oct.–3 Nov. 1967
(ANL-TRANS-556; CONF-671043-15) CFSTI: HC $3.00/MF $0.65

The fast-thermal ERMINE assembly in the MINERVE reactor is described. Reactivity and flux measurements and measurement techniques are described. Doppler effect and neutron importance measurements are discussed. Spectral index values are tabulated; results of reactivity measurements are listed. Data are shown graphically. NSA

N68-24742# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
SPECTRUM INDEX LU:DY MICRODISTRIBUTION MEASUREMENTS IN "ANNA" REACTOR LATTICES [POMIARY MIKROEOZKLADOW WBKAZNIKA WIDMOWEGO LU:DY W SIATKACH REAKTORA "ANNA"]
E. T. Jozefowicz, L. Adamski, and K. Jozefowicz 1967 11 p refs
(INR-821/IXA/PR)

The detailed results of spectrum index Lu–Dy microdistribution measurements in the elementary cells of ANNA reactor lattices are given and are compared with theoretical calculations using K-7 THERMOS Code. Author (NSA)

N68-24755# Nuclear Materials and Equipment Corp., Apollo, Pa.
PuO_2–UO_2–ZrO_2 FUEL DEVELOPMENT PROGRAM Progress Report, 1 Apr.–30 Jun. 1967
Nov. 1967 42 p
(Contract AT(30-1)-3505)
(NUMEC-3505-30; EURAEC-1946) CFSTI: HC $3.00/MF $0.65

Irradiation testing of six ternary fuel compositions in the PuO_2–UO_2–ZrO_2 system was continued and post irradiation examination was begun. The fuel system has potential application for plutonium recycling in thermal reactors now fueled with slightly enriched uranium such as Pressurized Water Reactors and Boiling Water Reactors. Phase diagram studies and melting point measurements were performed and reference samples were analyzed for oxygen-to-metal ratios and carbon content. NSA

N68-24759# Atomic Energy Commission Research Establishment, Riso (Denmark).
METALLURGY DEPARTMENT ANNUAL PROGRESS REPORT, PERIOD ENDING MARCH 31, 1967
Jul. 1967 42 p refs
(RISO-151)

Developments are reported for studies on: UO_2–Zircaloy fuel elements for water reactors; mechanical testing and metallography of Zircaloy-2; artificial hydriding of Zircaloy-2; dispersion-strengthened zirconium alloys; glove box with high-purity argon atmosphere; corrosion testing of Zircaloy-2; Zircaloy-4 and a zirconium–chromium–iron alloy; corrosion of stainless steel in boiling, concentrated seawater; mechanical properties in relation to structure of Al–Al_2O_3; effect of the shape of a second phase on fcc metals and alloys; dislocation densities in pure Al; irradiation effects on SAP; irradiations of pressure vessel steels; post irradiation effects on SAP; post irradiation examination of vibratory-compacted and pellet-filled UO_2 fuel pins as well as MTR fuel elements; fabrication of UO_2–Zircaloy fuel elements and MTR fuel elements; D_2O-loop boiling experiment; creep properties of Al–Al_2O_3; homogenized Al–Al_2O_3, micronizing and air separation of powder; preparation of UO_2 pellets and post irradiation examination of UO_2 pellets. NSA

N68-24779*# Techtran Corp., Glen Burnie, Md.
CALCULATION OF NEUTRON SPECTRA IN THERMAL REACTORS BY MEANS OF VARIOUS CODES [CALCOLO DI SPETTRI NEUTRONICI CON CODICI ETEROGENEI IN REATTORI TERMICI]
F. Orestano and F. Pistella Washington NASA May 1968 24 p Transl. into ENGLISH from the Italian Rept.
(Contract NASw-1695)
(NASA-TT-F-11671) CSCL 18K

In order to study and interpret experimental data on water-moderated Pu lattices a special method for neutron spectra evaluation has been developed by combining existing codes. Author

N68-24836# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
PURIFICATION OF THE HELIUM BLANKET OF NUCLEAR REACTORS BY ABSORPTION THROUGH A MOLECULAR SIEVE [EPURATION DE L'HELIUM DE COUVERTURE DES REACTEURS NUCLEAIRES PAR ADSORPTION SUR TAMIS MOLECULAIRE]
Jean Rozenberg and Henryck Kahan Dec. 1967 22 p refs In FRENCH
(CEA-R-3366)

A method carried out at fairly low temperatures (between −50 and −80°C) has been studied for the purification of helium used as cover gas for heavy water in reactors. The use of the 5A molecular sieve has been adopted because of its superiority over other adsorbants in this temperature range. The particular problems connected with adsorption under dynamic conditions have been dealt with separately. The nitrogen adsorption isotherms have been plotted and the heat of adsorption calculated. Author (NSA)

N68-24894# Oak Ridge National Lab., Tenn.
TUBE VIBRATION IN MSRE PRIMARY HEAT EXCHANGER
R. J. Kedl and C. K. Mc Glothlan 3 Jan. 1968 43 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2098) CFSTI: HC $3.00/MF $0.65

The primary heat exchanger for the Molten-Salt Reactor Experiment was completed in 1963. Preoperational tests with water revealed excessive tube vibrations and high fluid pressure drop on the shell side of the exchanger. Modifications were made to correct these deficiencies. From January 1965 through November

1967, the heat exchanger has operated for about 14,000 hours in molten salt without indications of leakage or change in performance. Author (NSA)

N68-24901# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
REACTOR CROSS SECTIONS FOR ^{242}PU ^{252}CF
J. A. Smith, C. J. Banick, R. L. Folger, H. P. Holcomb, and I. B. Richter 28 Feb. 1968 9 p refs Presented at 2d Conf. on Neutron Cross Sect. and Technol., Washington, D. C., 4–7 Mar. 1968
(Contract AT(07-2)-1)
(DP-MS-67-111; Conf-680307-10) CFSTI: HC$3.00/MF$0.65

A self-consistent set of cross sections for nuclides in the chain ^{242}Pu through ^{252}Cf was deduced from measured contents of ^{242}Pu samples exposed to nvt levels of 4 to 9 × 10^{22} n/cm^2 in a highly thermalized neutron spectrum. Some nuclides in the chain exhibit finite cross sections for fission as well as capture, so there are more cross sections to be determined than there are measurements. Independent measurements were used to complete the set. Author (NSA)

N68-24983# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
A STUDY OF HYDRAULIC AND NUCLEAR STABILITY OF BOILING WATER PARALLEL FLOW CHANNEL REACTOR SYSTEMS
J. R. Worden, D. S. Rowe, and P. J. Dionne Feb. 1968 173 p refs
(Contract AT(45-1)-1830)
(BNWL-574) CFSTI: HC$3.00/MF$0.65

Stability of a boiling, light water cooled, heavy water-moderated reactor has been studied by simulation on an analog computer. The model consists of a two-region reactor with coupling between the nuclear kinetics and hydrodynamics. Those parts of the reactor system external to the recirculating loop, such as turbines and feedwater pumps, were approximated by appropriate control functions. The simulation provides valid results over a range in power level from about 2/3 nominal up to the threshold of parallel channel instability. The reactor has an overall positive power coefficient of reactivity and requires automatic control. It is concluded from the study that the system is stable under a large variety of operating conditions, confirming results of design studies by AECL personnel. Author (NSA)

N68-24987# Gulf General Atomic, San Diego, Calif.
LATTICE PHYSICS STUDIES Quarterly Progress Report, Period Ending 31 Dec. 1967
G. D. Trimble, T. Gozani, P. d'Oultremont, and C. A. Preskitt 15 Jan. 1968 47 p refs
(Contract AT(04-3)-167)
(GA-8462; EURAEC-1981) CFSTI: HC$3.00/MF$0.65

Calculations of the single rod and lattice of uranium rods with water-to-uranium ratio of 4.18 have been completed. The calculations were made using the one-dimensional transport theory code 1DF. The experiment designed to measure the magnitude of any spectral distortion due to a reentrant hole has been performed. These data are now being analyzed. A code, GAMET, has been written, which corrects the measured time-dependent spectrum for the mean emission time of the neutrons. This code has been checked and is now operational. The experimental data for the single uranium rod and the 1.3-in. pitch of uranium rods have been reduced by both the conventional method using the HECTO code and the more sophisticated code GAMET. Preparations have been made for the spectral measurements in a tighter packed uranium lattice. A 2.06 water-to-uranium ratio lattice with a 1.0-inch pitch has been chosen. Calculations have been performed for the tighter packed uranium lattice using the one-dimensional transport theory code 1DF. Author (NSA)

N68-25044# California Univ., Livermore. Lawrence Radiation Lab.
EFFECTS OF CROSS-SECTION UNCERTAINTIES IN COMPACT SPACE POWER REACTORS
P. S. Brown, J. L. Watt, and R. J. Doyas 28 Feb. 1968 10 p refs Presented at the 2nd Conf. on Neutron Cross Sect. and Technol., Washington, 4–7 Mar. 1968
(Contract W-7405-ENG-48)
(UCRL-70797; Conf-680307-3)

The effects of cross-section uncertainties have been studied in compact (20 kWe to 10 MWe) space power reactors. Three systems were considered having core sizes of 12, 78, and 525 liters and median fission energies of 560, 380, and 200 keV, respectively. Each core contained UN fuel, W–Re–Mo alloy cladding, and Li coolant within a Ta pressure vessel and BeO reflector. The cross sections of each material were perturbed 10%, and downscatter terms of each scattering matrix were increased 50%. Reactivity effects were computed for these perturbations with the ZOOM diffusion code with tight convergence. The size of perturbations was varied to demonstrate linearity. Because of hardness of the spectra, the perturbations had significant effects only above 10 keV. The additivity of groupwise and materialwise cross-section changes was examined to determine interaction between the various perturbations. Calculations were done to determine the sensitivity of the spectrum shape, fission ratios, reactivity worths, and neutron lifetime to cross-section uncertainties, and to evaluate whether measurement of such parameters in critical experiments can be useful in testing cross-section data. Author (NSA)

N68-25048# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
REACTIVITY EFFECT OF MODERATOR VOIDS IN A CANDU LATTICE
R. E. Green Jan. 1968 26 p refs
(AECL-3002) Available from Atomic Energy of Canada, Ltd., Chalk River: $1.00

Experiments were performed in ZED-2 to determine the reactivity effect of voids in the moderator of a CANDU-type lattice. From measurements with a small void located at various positions in the lattice, it was possible to separate the flux-dependent and gradient-dependent effects and to derive constants that may be used to determine the reactivity effect of a similar void in CANDU. The experiments showed that in ZED-2 a moderator void produces a negative reactivity change at all points in the reactor. The absolute value was larger near the edges than at the center in ZED-2, but the effect is predicted to be greatest at the center of the CANDU reactor. This is due to the influence of the flux gradient which is much larger in ZED-2 than in CANDU. Measurements with a very large void (simulating removal of all moderator from the central cell) gave a much larger negative reactivity effect than that predicted from the superposition of many small void effects. This difference is believed to be partly due to neutron streaming in the larger void, an effect that should be less in a large power reactor. Author (NSA)

N68-25058*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland Ohio.
AGES OF D(D,N)HE SUP 3 AND T(D,N)HE SUP 4 NEUTRONS IN WATER AND TUNGSTEN-WATER MIXTURES
Roger L. Alexander, Donald F. Shook, and Donald Bogart Washington May 1968 22 p refs
(NASA-TN-D-4581) CFSTI: HC$3.00/MF$0.65 CSCL 18J

Ages for D–D and D–T neutrons were measured. Experimental and calculated ages were in agreement for water, but measured ages exceeded calculated ages for tungsten–water mixtures. The discrepancy increases with an increase in the volume fraction of metallic tungsten in the tungsten–water mixture. The most probable

reasons for the discrepancy are incomplete data for the partial inelastic cross sections of the tungsten isotopes and the inadequacy of the evaporation model used to represent inelastic scattering above 1.5 MeV in the GAM II cross section compilation. Author

N68-25092# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

MEASUREMENTS OF THE PULSE RESPONSE OF A VERY SUBCRITICAL REACTOR (AQUILON, NOVEMBER 1965) [MESURES DE RESPONSE IMPULSIONNELLE D'UN REACTEUR TRES SOUS-CRITIQUE (AQUILON, NOVEMBRE 1965)]

Jean Cazemajou and Lucien Beliard Dec. 1967 44 p refs In FRENCH
(CEA-R-3336)

The results of a series of experiments carried out on AQUILON in November 1965 by the pulsed neutron method are presented. Experimental constants for a very sub-critical medium, as little heterogeneous as possible, were obtained. The effect of the reflector had been eliminated by surrounding the core with a Cd skirt; the change in antireactivity was obtained as a result of modifying the Laplacian by changing the level of the moderator. About twenty measurements were effected between the critical level and the zero level. The use of a fast channel made it possible to obtain precise results in a relatively short time. Author (NSA)

N68-25131# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

CONSIDERATIONS CONCERNING THE RELIABILITY OF REACTOR SAFETY EQUIPMENT [CONSIDERATIONS SUR LA FIABILITE DES ENSEMBLES DE SECURITE DES REACTEURS]

Jacques Furet and Christian Guyot Sep. 1967 39 p refs In FRENCH
(CEA-R-3292)

The large amount of data available necessitates the use of a computer for analyzing the results. Reliability of the electronics used for nuclear reactor control will be dealt with: safe and unsafe failures, probability of survival (in the case of reactor safety) availability. The general diagrams of the safety assemblies which have been drawn up for power reactors and low power experimental reactors are given. Results of reliability analysis which could be applied to use of functional modular elements are presented. Improvement of this reliability appears fairly limited by increased redundancy; however it may be greatly improved by use of different frequency signals for detecting unsafe failure rates for the subassemblies. Examples show complexibility of reactor safety equipment and system dependence on reliability. Author (NSA)

N68-25135# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Energeticheskii Institut.

REACTIVITY INTEGRAL THEOREM FOR A CRITICAL REACTOR [TEOREMA OB INTEGRALE REAKTIVNOSTI KRITICHESKOGO REAKTORA]

E. A. Stumbur 1967 12 p In RUSSIAN
(FEI-77)

A theorem is derived for relating the reactivity integral coefficients for a critical reactor with the values of the medium property gradients, or with the boundary reactivity coefficient values in the case of a homogeneous zone reactor. The proof is given on the basis of the general critical reaction in which all the values are energy-dependent. The theorem is limited only by the requirements of convexity and homogeneity of the inner reactor boundary. NSA

N68-25163# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

IMPROVEMENT IN THE INSENSITIVITY OF PULSE AMPLIFIERS TO INTERFERENCE [AMELIORATION DE L'INSENSIBLITE AIJX PARASITES DES AMPLIFICATEURS D'IMPULSIONS]

Jacques Buisson and Jean Garau Nov. 1967 11 p In FRENCH
(CEA-R-3333)

The level of background noise around certain reactors is often so great that the operation of pulse assemblies is strongly affected. A few practical precautions are described which make it possible to decrease sensitivity to parasitics. Results obtained on two reactors, G 1 and AQUILON, are described. Author (NSA)

N68-25164# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

INTRODUCTION TO THE STUDY OF BOILING IN WATER REACTORS [INTRODUCTION A L'ETUDE DE L'EBULLITION DANS LES REACTEURS A EAU]

Bernard Froelicher Nov. 1967 12 p In FRENCH
(CEA-R-3327)

In order to plot the low- and high-power transfer function for a reactor using its background, a conventional method is proposed for estimating the efficiency of a CC5 chamber connected to a direct current detection system. Author (NSA)

N68-25166# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

RESPONSE OF A FAST REACTOR TO A NEUTRON SOURCE [REPONSE D'UN REACTEUR RAPIDE A UNE SOURCE DE NEUTRONS]

Jean Moret-Bailly Nov. 1967 72 p In FRENCH
(CEA-R-3351)

In the multigroup approximation, a fast homogeneous bare reactor has properties which for each spatial harmonic can be summed up by a matrix A. A classification of reactors is made as a function of this structure which varies with the considered medium. The eigenvalues of A are the decay constants obtained with a pulsed neutron source. In the spectrum of these eigenvalues, is often a marked line related to a fundamental. The line is not always single. The neutron spectrum may be calculated from the eigenvectors. A neutron source, according to its spectrum, excites more or less the various energy harmonics. The detector, for its part, does not have the same response to all harmonics. Phenomena are symmetrical. Equations of this problem are written in matrix form and applied to sources which can be pulsed, modulated, or controlled by the reactor flux. FORTRAN IV codes for computing the behavior of the detector response are described. Some of these codes use subroutines more accurate than usual ones for computation of eigenvalues and eigenvectors. Author (NSA)

N68-25172# Commissariat a l'Energie Atomique, Grenoble (France).

THE SHAPING AND IRRADIATION OF URANIUM MONOCARBIDE Quarterly Report, 1 Apr.–30 Jun. 1967

J. Devillard and G. Morlot 30 Jun. 1967 29 p Transl. into ENGLISH from French Sponsored by the Joint US EURATOM Res. and Develop. Program
(EURAEC-1980; EUR-3779; QR-24) CFSTI: HC $3.00/MF $0.65

The SIL 5 irradiation of 8% ^{235}U enriched uranium carbide was placed in pile with a linear FR loss of around 1000 W/cm. From interpretation of the irradiation thermal parameters it may be assumed that the core temperature of the SIL 5 fuel is 1250°C with a thermal gradient in the carbide of 440°C. The E2 irradiation of a 2% ^{235}U enriched uranium carbide pencil is continuing favorably. The 2100 MWd/t burn-up ratio was attained with a linear FR loss of 800 W/cm. Construction of the CYRANO capsule is continuing. Author (NSA)

N68-25173# AEG-Kernenergieanlagen, Frankfurt am Main (West Germany).
STABILITY TESTS ON BOILING WATER REACTORS Quarterly Report, 1 Jul.–30 Sep. 1967
30 Sep. 1967 49 p refs Transl. into ENGLISH from German Sponsored by the Joint US/EURATOM Res. and Develop. Program
(EURAEC-1964; EUR-3773; QR-11) CFSTI: HC$3.00/MF$0.65

Tests were performed during flow oscillations in the four rod clusters geometry test section. Altogether 16 transfer functions "water inlet velocity–local void fraction" were measured, different test parameters being varied: heat flux, subcooling and mean mass flow rate. These parameters were chosen in such a way that it will be possible to compare the obtained transfer functions with the heat flux oscillation measurements. During the recent tests, local void fraction measurements were made at four axial positions along the boiling length to obtain sufficient signals for void fraction integration. To study undesirable influences on measured transfer functions void fraction oscillations in conjunction with constant heat flux and constant water inlet velocity were analyzed as a function of frequency. Two computer codes, FREGA and IVS-MAUS, used for the test evaluations were combined to the new program FREGAUS for simplification. Author (NSA)

N68-25174# Institutt for Atomenergi, Halden (Norway).
IN-PILE AND OUT-OF-PILE HYDRODYNAMIC STUDIES ON NATURAL CIRCULATION BOILING WATER CHANNELS
T. J. Bjoerlo, T. Eurola, R. Grumbach, J. E. Lunde, J. H. Post et al Dec. 1967 140 p refs
(HPR-82)

The hydrodynamic performance of natural circulation boiling water channels was investigated both in the Halden Boiling Water Reactor and in an out-of-pile loop. In-pile dynamic coupling experiments were also performed. Tubular fuel assemblies in natural circulation were used. The assemblies were equipped with instruments permitting dynamic measurements of channel power, temperature, coolant velocity and exit void fraction. Sinusoidal perturbations in channel heat flux were applied. The experimental results include steady state hydraulic characteristics, approaches to flow instabilities as determined by noise analysis, and transfer functions from heat flux to coolant inlet velocity and to exit void fraction. The transfer functions relating the perturbed flow to the flow in the neighbouring channel and to the neutron flux and the vessel pressure were determined. Noise technique was used to determine the auto-power density spectra of these variables. Author (NSA)

N68-25227# Oak Ridge National Lab., Tenn.
OAK RIDGE RESEARCH REACTOR Quarterly Report, Oct.–Dec. 1967
W. H. Tabor and S. S. Hurt, III 28 Feb. 1968 48 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2147) CFSTI: HC$3.00/MF$0.65

Operating experience, instrument and process maintenance, and experiment activities are tabulated and items of particular interest are indicated. Special tests conducted included efficiency tests of off-gas and cell-ventilation systems filters and reactivity and flux change measurements on a cadmium–boron neutron filter installed in the fuel region of the core. The sudden increase in cadmium contamination of reactor cooling water and the checks of a slightly corroded cadmium shim rod thought to be responsible for the contamination are described in detail. NSA

N68-25252# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
REPORT OF BLIND STARTUP EXPERIMENTS CARRIED OUT ON THE REACTOR CABRI BETWEEN JULY 4 AND 8, 1966 [COMPTE RENDU DES EXPERIENCES DE DEMARRAGE EN AVEUGLE EFFECTUEES SUR LE REACTEUR CABRI DU 4 AU 8 JUILLET 1966]
Nadejda Filipczak, Wieslaw Filipczak, Jacques Furet, and Josef Kaiser Nov. 1967 24 p ref In FRENCH
(CEA-R-3341)

The blind startup of a reactor without any neutronic data concerning a relatively wide range of power dynamics can be necessary when difficulties arise in the positioning of the detector or in neutron–gamma discrimination near the multiplying medium. The object of the experiments carried out on the reactor CABRI was to check the very complete analysis of the startup accident which was studied on an analogue computer. The number of experiments carried out is not sufficient to allow a definite conclusion. Nevertheless the blind startup method presented does not appear to be incompatible with the safety of reactors such as CABRI during the operational phase. Author (NSA)

N68-25258# Oak Ridge National Lab., Tenn.
SOME RECENT NUCLEAR CROSS SECTION MEASUREMENTS AT ORNL, OCTOBER 1, 1967–FEBRUARY 29, 1968
P. H. Stelson Mar. 1968 20 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2159) CFSTI: HC$3.00/MF$0.65

Some recent measurements of differential cross sections and γ spectra for the reactions $^{14}N(n,n')^{14}N$, $^{14}N(n,p)^{14}C$, and $^{14}N(n,\alpha)^{11}B$; the neutron total cross section of ^{16}O; γ spectra from resonance and thermal neutron capture by ^{140}Ce, ^{39}K, ^{41}K, ^{185}Re, ^{187}Re, ^{203}Tl, ^{205}Tl, ^{112}Sn, ^{114}Sn, and ^{115}Sn; and capture and fission cross sections for ^{239}Pu from thermal to 30 keV and for ^{233}U from thermal to 1 eV are summarized. Calculations of the elastic and inelastic scattering cross sections for ^{56}Fe are also reported, as is the status of the electron linear accelerator. NSA

N68-25265# Gulf General Atomic, San Diego, Calif.
NEUTRONIC MEASUREMENTS IN NON-CRITICAL MEDIA
C. A. Stevens [1967] 34 p refs Presented at the 2d Conf. on Neutron Cross Sect. and Technol., Washington, D. C., 4–7 Mar. 1967
(Contract AT(04-3)-167)
(GA-8466; CONF-680307-19) CFSTI: HC$3.00/MF$0.65

Several types of subcritical experiments that are intended to provide integral checks of cross sections and computational methods in fast reactors and fast neutron shielding are dicussed. These include studies of the time response to a pulsed neutron source, steady-state neutron spectrum measurements, and transmission measurements. The methods which are used to analyze these experiments are described, with the emphasis placed on what cross section information can be extracted from them. A description of how cross section averaging procedures are actually performed in some of the more sophisticated codes designed for this purpose is included. Author (NSA)

N68-25272# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
ADI ITERATION: THEORY AND APPLICATION TO REACTOR CRITICALITY CALCULATIONS
[1968] 10 p refs Presented at the 20th Symp. on Applied Math., Durham, N. C., 5–6 Apr. 1968
(Contract W-31-109-ENG-52)
(KAPL-P-3400; CONF-680405-1) CFSTI: HC$3.00/MF$0.65

A basic iterative procedure is applied to the Chebyshev minimax theory for solution of the elliptic boundary value problems which occur in reactor criticality calculations. The iterative procedure is formulated by a tri-diagonal matrix for computation of the lower eigenvalue bounds. The eigenvalue bounds are then applied to the Chebyshev minimax theory to yield eigenfunctions of the differential operator that are separable. NSA

N68-25275# United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center.

PERFORMANCE EVALUATION OF HEAT EXCHANGERS FOR SODIUM COOLED REACTORS Quarterly Technical Progress Report, 1 Oct.–31 Dec. 1967

S. L. Israel, D. J. Nolan, and F. B. Malmborg 20 Jan. 1968 41 p (Contract AT(11-1)-1452)

(UNC-5200) CFSTI: HC $3.00/MF $0.65

The evaluation of the thermal-hydraulic and structural performance of heat exchangers for sodium-cooled reactor plants is discussed. The evaluation will be based on the results of tests of model heat exchangers [approximately 30 MW(t)] in the Sodium Components Test Installation (SCTI). An intermediate heat exchanger designed and manufactured by ALCO Products, Inc., (ALCO) and a steam generator designed by ALCO and manufactured by Baldwin-Lima-Hamilton Corporation (BLH) are the first units to be tested. A Babcock & Wilcox (B&W) steam generator is to be tested next. Several sets of test data were utilized to confirm that the temperature distributions in the lower tube-sheet area of the ALCO/BLH steam generator were not axially symmetric, as had been assumed by ALCO in calculating stresses in this structurally critical region. The presence of the sodium outlet nozzle and sodium bypass flow through a drain slot in the shell liner were investigated as possible causes for this condition. A review of the entire instrumentation system was initiated to assure that all necessary information was available for proper reduction and interpretation of experimental data. As a result of this review, some changes in instrumentation, especially for strain gages, were recommended. The latest revision to the Steady State Performance Test Procedures (SCTI-C-1002) was reviewed. Intermediate heat exchanger vibration tests were witnessed. Explanations were sought for vibration peaks at certain frequencies and flow rates. Tube vibration and entrained gas are possible causes for the vibrations, but further tests were suggested to substantiate these hypotheses. Author (NSA)

N68-25283*# Avco Corp., Lowell, Mass. Space Systems Div.

ISOTOPE REENTRY VEHICLE DESIGN STUDY: CONCEPTUAL DESIGN, PHASE 1A TOPICAL REPORT

May 1968 528 p refs

(Contract NAS3-10938)

(NASA-CR-72366; AVSSD-0071-68-CR) CFSTI: HC $3.00/MF $0.65 CSCL 18N

Document summarizes the Phase IA conceptual design effort on the Isotope Reentry Vehicle (IRV) study. The major objective of the study is to develop a preliminary design of a 25 KW_t Pu 238 IRV. Major design emphasis is on system safety and developability. The IRV is configured to meet minimum practical diameter and weight limits. During Phase IA various IRV, heat source, and heat-source heat exchanger concept combinations have been developed and evaluated. Three IRV systems have been recommended for detailed conceptual design evaluation in Phase IB. Author

N68-25306# Mainz Univ. (West Germany). Institut fuer Anorganische Chemie und Kernchemie.

NUCLEAR RESEARCH [KERNFORSCHUNG] Annual Report, 1966

Bad Godesberg, W. Germany Bundesmin. fuer Wiss. Forschung Dec. 1967 121 p refs In GERMAN Sponsored by Bundesmin. fuer Wiss. Forschung

(BMWF-FBK-67-89)

Construction and performance of a TRIGA reactor and performance of a Cockcroft–Walton accelerator are discussed. Research in nuclear chemistry and radiochemistry included: separation of fission products, counting techniques, and analysis of data; decay properties of short-lived nuclei; and distribution of mass and charge in the fission of heavy nuclei by thermal and 14-MeV neutrons. Research in analytical chemistry and spectrochemistry is reported. Studies in inorganic preparative chemistry and X-ray analysis are described. Author (NSA)

N68-25319# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

PROGRAM FOR ELIMINATION OF NEUTRON POISONS FROM NUCLEAR REACTORS [ELIMINATION PROGRAMMEE DE POISONS NEUTRONIQUES DES REACTEURS NUCLEAIRES]

Gisele de la Perriere Nov. 1967 83 p refs In FRENCH

(CEA-R-3274)

The use of salts of elements having a large neutron capture cross section, which are dissolved in the moderating water to control the reactivity of heavy water reactors, and more particularly to compensate the Xe effect in the reactor EL 4 is discussed. The controlled elimination of these poisons by fixation on ion exchange resins is described. The poisons considered are ^6Li, Cd and Gd in the sulfate form, and B as H_3BO_3. The thermodynamic and kinetic constants of the ion exchange reactions were first determined and a study was then made of the fixation of these compounds in beds of small calibre resins placed in columns. ^6Li is the poison most easily applicable to compensate for the Xe effect in the EL-4. Author (NSA)

N68-25349# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.

CONTROL ROD OSCILLATOR TESTS, GARIGLIANO NUCLEAR REACTOR

R. T. Lahey, Jr., C. L. Howard, M. J. Calcagno, E. Vincenti, and G. L. Santarossa Aug. 1967 306 p refs

(Contract AT(04-3)-189)

(GEAP-5534, Pt. 1; EURAEC-1941) CFSTI: HC $3.00/MF $0.65

The results of an extensive series of rod oscillator tests performed on the Garigliano boiling water reactor are presented. Both the numerical results and the individual plots obtained from digital reduction of the data are documented in detail. Details of the test procedures and equipment are also included. Appendixes contain descriptions of the method of data reduction, the anticipated errors, and FORTRAN listings used in the data reduction. NSA

N68-25352# Commissariat a l'Energie Atomique, Chuscian (France). Centre de Production de Plutonium de Marcoule.

RADIOACTIVE CONTAMINATION NEAR NATURAL URANIUM-GRAPHITE-GAS REACTORS [LA POLLUTION RADIOACTIVE AUPRES DES PILES URANIUM NATUREL-GRAPHITE-GAZ]

Jean Chassany, Jacques Pouthier, and Jean Delmar Nov. 1967 24 p refs In FRENCH

(CEA-R-3311)

The results of numerous evaluations of contamination are given: reactors in operation during maintenance operations; reactors shut down during typical repair operations following incidents on the cooling circuit and can-rupture. They show that, except in particular cases, it is the activation products which dominate. Furthermore, after ten years operation, the points at which contamination liable to emit strong doses accumulates are very localized. Author (NSA)

N68-25359# General Electric Co., Sunnyvale, Calif. Advanced Products Operation.

SHORT-TERM FAST FLUX (EBR-2) IRRADIATION OF PuO_2–UO_2 FUEL PINS

S. A. Rabin, W. W. Kendall, and W. E. Baily Oct. 1967 70 p refs

(Contract AT(04-3)-189)

(GEAP-5570) CFSTI: HC $3.00/MF $0.65

Results of the initial fast flux irradiation of mixed oxide fuel pins in EBR-II are described. Major objectives of the test were to obtain data on short-term fuel performance in a fast spectrum and to serve as a precursor to high burnup irradiations. Six encapsulated fuel pins incorporating a variety of design and fabrication parameters were irradiated to a relatively low burnup and examined. All of the specimens behaved satisfactorily, and specimens with target burnups of 50,000 to 100,000 MWd/te were subsequently inserted in EBR-II. Author (NSA)

N68-25374# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

THE REACTOR PHENIX: CARTRIDGE RUPTURE DETECTION [REACTEUR "PHENIX" LA DETECTION DE RUPTURES DE GAINE]

Jean Graftieaux Nov. 1967 13 p In FRENCH
(CEA-R-3339)

The role of cartride rupture detection in the reactor PHENIX is defined. It gives the possible methods, their probable performances, their advantages and disadvantages. The final form of the installation will be determined mainly by the degree of safety required, by the technical possibilities of the reactor design and by the operational flexibility wanted. Author (NSA)

N68-25389# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

STUDY OF THE RELIABILITY OF AUTOMATIC CONTROL SYSTEMS FOR NUCLEAR REACTORS [ETUDE DE LA FIABILITE DES SYSTEMES DE PILOTAGE AUTOMATIQUE DES REACTEURS NUCLEAIRES]

Cornel Tapu Dec. 1967 32 p refs In FRENCH
(CEA-R-3380)

The reliability of automatic control systems which can be applied to nuclear reactors is evaluated. The calculations which have been carried out make possible the orientation of the choice of the scheme and of the elements used, as a function of the operational safety. Sequential and parallel redundance showing the importance of the detection of active and passive failures, and of the maintenance are investigated. The failure rate coefficients for the elements used in an automatic control system design have been calculated using the data given by the "R.A.D.C. Reliability Note Book." Author (NSA)

N68-25403# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Energeticheskii Institut.

INVESTIGATION OF THE PHYSICAL CHARACTERISTICS OF A WATER-MODERATED WATER-COOLED REACTOR WITH BURNABLE POISON [ISSLEDOVANIE FIZICHESKIKH KHARAKTERISTIK VODO-VODYANOGO REAKTORA S OBGORAYUSHCHIMI POGLOTITELYAMI]

E. I. Inyutin, G. A. Karchava, V. I. Matveenko, I. G. Morozov, Yu. I. Orekhov et al 1967 16 p refs In RUSSIAN
(FEI-88)

Results of theoreticlal and experimental investigations of the reactor designed to power a small generating plant are reported. The measurements were done at 20-230°C. The setup described consisted of fuel assemblies with stainless steel sheaths and highly enriched uranium. The design permitted the introduction of various burnable poisons such as boron steel sheet or Gd and Cd-filled rods. A study was made of the compensating capacity of the burnable poison rods as a function of their number and distribution in the core, fuel distribution, and the temperature effect of assemblies containing blocked (Gd and Cd) and unblocked (B) poison. NSA

N68-25419# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).

MULTIGROUP ANALYSIS FOR THE DETERMINATION OF THE BEST SPECTRAL INDEX IN THE MEASUREMENT OF K_∞ BY THE METHOD OF NULL REACTIVITY [ANALISI A MOLTIGRUPPI PER LA DETERMINAZIONE DEL MIGLIOR INDICE SPETTRALE IN MISURE DI K_∞ COL METODO DELLA REATTIVITA NULLA]

F. Casali 1967 36 p refs In ITALIAN; ENGLISH summary
(RT/FT(67)30)

A study to decide what detector or combination of detectors which will give the best information about the neutron spectrum matching k_∞ measurements performed by the null reactivity method is presented. Test configurations include: graphite moderated lattices with natural uranium as fuel; and heavy water moderated lattices with natural or slightly enriched (^{235}U or ^{239}Pu) uranium as fuel element. Results show that the CaR of a resonance detector is as accurate as the $^{235}U/^{238}U_{SD}$. The CaR measurements were performed for Au, Mn, and for ^{235}U fission chamber for two neutron spectra. The variations of these spectral indexes were the same order of magnitude. Author (NSA)

N68-25423# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

LINEAR SYSTEMS SURVIVING THE FIRST BREAKDOWN [SYSTEMS LINEAIRES SURVIVANT A LA PREMIERE PANNE]

Jacques Uberschlag Nov. 1967 23 p refs In FRENCH
(CEA-R-3335)

Linear safety systems for reactors, in which redundancy of like signals is not required, are described. The designs of systems, which require coincidence-redundancy, are given. Operation of, and errors and detection in such systems are briefly considered. (NSA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N68-24350# California Inst. of Tech., Pasadena. Quantum Electronics Lab.

THEORY OF HOLOGRAPHY

John W. Matthews Jun. 1967 274 p refs
(Contract AF 49(638)-1322)
(AFOSR-68-0673; SR-7; AD-667189)

The holographic process is studied from the point of view of a thick hologram. The theoretical analysis is reduced to a diffraction grating problem. The hologram takes the form of a grating in the sense that the initial exposing field induces in the emulsion a sinusoidal distribution of particles extending over a 3 dimensional array which in turn diffracts the applied illumination field. Both the initial exposing field and illumination field are assumed to consist of a sum of plane waves. The amplitude, phase, and direction of the first order diffracted wave is calculated for an individual plane wave and the results summed coherently for a sum of plane waves. Multiple scattering is neglected. In comparison with previous thick hologram analyses, the present study includes the following additional factors: the applied illumination can have arbitrary directions, attenuation and reflection losses are included. In comparison with the thin hologram transmittance analyses, it was found that the results are equivalent as far as direction and phase of the diffracted beams are concerned. The duplication of holograms is studied in terms of making a hologram of a hologram

rather than in terms of making a contact print. Both transmission and reflection holograms are investigated. Certain of the theoretical results were compared with experimental studies of a holographic diffraction grating with good agreement. Author (TAB)

N68-24441*# University of Southern Calif., Los Angeles. Dept. of Physics.
DEVELOPMENT OF A HIGH-INTENSITY, NANOSECOND, PULSED VACUUM ULTRAVIOLET LIGHT SOURCE Final Technical Report, Oct. 1966–Jan. 1968
G. L. Weissler 31 Jan. 1968 23 p refs
(Contract NAS2-3846)
(NASA-CR-73222) CFSTI: HC $3.00/MF $0.65 CSCL 20F

A high intensity, nanosecond, pulsed vacuum ultraviolet light source was tested, with the optical environment was a vacuum of better than one micron. Two methods of operating the source are described: (1) a laser-produced metal vapor fireball, either alone or enhanced by a condenser discharge, and (2) a free-running progress on the grazing incidence instrument. Simultaneously with the grazing incidence instrument research, some work was done with a normal incidence spectrograph on the number of photoelectrons emitted per laser pulse in a narrow wavelength region by using a simple photocell. Further effort is required to make a low-capacity plane parallel condenser source into a routinely operated spectroscopic source. M.W.R.

N68-24442# Canadian General Electric Co., Ltd., Toronto (Canada). Electronic and Defence Products Dept.
HOLOGRAPHY
T. Toong Dec. 1966 42 p refs
(RQ66EE15)

This report is based on abstracts of some two hundred recent articles on the subject of holography or wave-front reconstruction. Abstracts of related papers are grouped together, with the aim of presenting also a survey of the various aspects of present day holography. Author

N68-24544 California Inst. of Tech., Pasadena.
MICROCYCLE SPECTRAL ESTIMATION
David Jordan Blakemore (Ph.D. Thesis) 1966 367 p
Available from Univ. Microfilms: HC $16.65/MF $4.70 Order No. 67-190

This thesis estimates the power spectral density of low frequency semiconductor noise over a range of 10 decades, from a microcycle (10^{-6} cps) to 10 kilocycles (10^{+4} cps). It is concluded that the behavior is more complex than a simple inverse proportionality to frequency. The spectrum is approximately $1/f$ in the region around 100 cps and changes gradually to $1/f^2$ as the frequency decreases to the microcycle region. These spectra represent the noise properties of the first stage transistors of a grounded input dc differential amplifier. The estimated spectra at very low frequencies still reflect strong temperature influences. In order to obtain these measurements it was necessary to control the temperature environment of the noise source. This was accomplished first by passive attenuation and later by active control. The noise source was placed in a circulating oil bath whose temperature was sensed electrically and controlled to a .001°C range. Dissert. Abstr.

N68-24552# Royal Aircraft Establishment, Farnborough (England).
ANHYSTERETIC AND REMANENCE CURVES OF METALLIC RECORDING MATERIALS [ANHYSTERESE UND REMANENKURVEN IN METALLISCHEN WERKSTOFFEN ZUR MAGNETISCHEN AUFZEICHNUNG]
O. Henkel Jan. 1968 23 p refs Transl. into ENGLISH from IEEE Trans. Magnetics, v. 2, no. 3, Sep. 1966 p 212–220
(RAE-LIB-TRANS-1289) CFSTI: $3.00

The remanent magnetization of some workable, hard magnetic materials was measured by different methods as a function of the applied field. The results are well suited for providing information on the interaction between the fine particles within an assembly. The anhysteretic susceptibility is discussed, in connection with the so-called triplet-curves of remanent magnetization, with regard to the conceptions derived from the pair-model. Quantitative indications on interaction fields are given from the deviation from the Gaussian distribution with logarithmic divided abscissa occurring in practical assemblies. As a rule, they accordingly consist of a negative, magnetization-independent and a positive, magnetization-dependent term. In any case, small differences from the triplet-curves of remanent magnetization must not be a symptom of little interaction; it may be feigned by the superposition of the two terms. Finally, partial remanent magnetization is discussed. If interactions occur, the additive law is no longer valid. It is shown that, under certain conditions the effect of the magnetization-dependent term may be suppressed. Author

N68-24664# Suffield Experimental Station, Ralston (Alberta).
A METHOD FOR EVALUATIONG THE PERFORMANCE OF VERY LONG EXPLOSIVE CHARGES
J. Watson and E. Huestis 22 Feb. 1968 14 p refs
(Suffield-MEMO-60/67) CFSTI: HC $3.00/MF $0.65

A method for evaluating the performance of very long, small diameter, TNT stick charges is proposed. The points to be evaluated are the mechanical adequacy of the mounting arrangement and the stability of the detonation process along the segmented stick charge. The test described herein indicates that field testing of this charge shape is practical and inexpensive. Author

N68-24681# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ORBITING AND RESONANCE STATES [ORBITIROVANIE I REZONANSNYE SOSTOYANIYA]
I. Lukach and Ya. A. Smorodinskii 1968 23 p refs In RUSSIAN
(JINR-P2-3692)

The behavior of the characteristics of an elastic potential scattering process at energies of the order of the effective potential barrier is investigated in the framework of the quantum mechanics. This phenomenon is known in the classical scattering theory as orbiting (helicity scattering). It is found out, that at the energies of incident particles equal to the height of an effective potential barrier, there appears a resonance corresponding to the quasi-stationary state. The effective potential barrier height is an angular momentum function of incident particles and thus one obtains the resonance trajectory determining the family of resonance energies for different angular momenta. Author (NSA)

N68-24697# Weizmann Inst. of Science, Rehovoth (Israel).
SCIENTIFIC ACTIVITIES 1967
[1968] 291 p refs

Research efforts in the biological, chemical, mathematical, and physical sciences are summarized; and facilities and personnel of the Weizmann Institute of Science are listed in an annual report. Activities are reported under the headings of biochemistry, biodynamics, biological ultrastructure, biophysics, cell biology, and genetics and plant genetics. Other categories include chemical immunology, chemical physics, chemistry, and isotope research; as well as applied mathematics, electronics, nuclear physics, and polymer research. M.W.R.

N68-24698# Weizmann Inst. of Science, Rehovoth (Israel).
APPLIED MATHEMATICS
C. L. Pekeris et al *In its* Sci. Activities 1967 [1968] p 1–10 refs (See N68-24697 14-23)

Abstracts of published papers in applied mathematics deal with the expansion of the Golem A computer system, advanced computer development, and Gaussian integration in the presence of a singularity. An exact solution is obtained for the displacement of the surface of a uniform elastic solid sphere, and viscous flow was studied in a pipe with absorbing walls. Numerical solution of theoretical seismic problems, wave theory intrinsic to seismology, and determination of periods in seismic records were investigated; and the stability of plane Poiseuille flow was studied under periodic disturbances of finite amplitude in the vicinity of the neutral curve. Laplace's tidal equations were solved for the real world oceans with a coastal boundary defined by one degree arcs of latitude and longitude. M.W.R.

N68-24720# Lockheed Missiles and Space Co., Palo Alto, Calif.
PRESSURE FIELD WITHIN A SHELL PERFORMING RANDOM VIBRATIONS
V. V. Bolotin 1968 9 p refs Transl. into ENGLISH from Inzh. Zh., Mekh. Tverdogo Tela (Moscow), no. 1, 1968 p 74–81

A method is given for the analysis of the vibrations of an elastic shell in contact with an acoustic medium and loaded by random forces. The variance, correlation functions, and spectral densities of the pressure in the acoustic medium are determined taking account of dissipation in the shell and in the sound insulating layer. Author

N68-24777# National Physical Lab., Teddington (England).
THE EVALUATION OF NOISE FROM FREELY FLOWING ROAD TRAFFIC
D. R. Johnson and E. G. Saunders Aug. 1967 37 p refs
(NPL-AERO-AC-29) CFSTI: $3.00

Roadside surveys of the noise emitted by freely flowing traffic have been made on sites varying from motorways to urban roads. The results provide a basis for comparing future with present-day traffic noise levels and show how noise emission varies with traffic flow, composition, speed and distance from the roadside. Using the experimental data in combination with a theoretical analysis of simple vehicle flow, a method has been obtained for predicting traffic noise levels under any given operating conditions. Author

N68-24789# Rice Univ., Houston, Tex. Dept. of Space Science.
ON THE MEASUREMENT OF DIFFERENCES BETWEEN THE GRAVITATIONALLY INDUCED ELECTRIC FIELDS NEAR VARIOUS METALS
F. Curtis Michel [1967] 12 p refs
(Contract F19628-67-C-0166)

The tangential component of an electric field near a metal is entirely described in terms of a variation in work function, provided that conservative forces are present; with a closed circuit of conductors in any combination generating no EMF under equilibrium conditions because the system is conservative. Further, it is noted that there would be no deflection of an electrostatic voltmeter, continuously hooked across any two points, even if the work functions at those points were to change. If the electrostatic potentials of the system change because of work function variations when the system is inverted, some charge rearrangement might be expected; and this might amount to a few dozen electrons if the scale is of the order of a meter. The current would flow through the path of least impedance, which would be the shunt rather than the voltmeter. These comments were made in relation to an experiment, which leaves open the question of a compositional dependence to the gravitationally induced electric field near a metal. M.W.R.

N68-24843# Instituto de Energia Atomica, Sao Paulo (Brazil). Divisao de Fisica Nuclear.
MATRIX REPRESENTATION FOR CALCULATION OF THE SECOND ORDER ABERRATIONS IN PARTICLE OPTICS FOR HOMOGENEOUS AND INHOMOGENEOUS (N = 1) MAGNETIC FIELDS
A. A. Suarez and F. A. B. Coutinho Apr. 1967 25 p refs
(IEA-144) CFSTI: HC $3.00/MF $0.65

The general theory of beam transport optics was used to find out the matrix elements corresponding to the motion of a particle in homogeneous and inhomogeneous magnetic fields. This theory was extended for the rotation of the field boundary. Author

N68-24900# General Electric Co., St. Petersburg, Fla. Pinellas Peninsula Plant.
ANALYSIS OF THE ELECTRIC FIELD BETWEEN PARALLEL WIRES
C. C. Scheid 16 Feb. 1968 9 p ref
(Contract AT(29-2)-656)
(GEPP-19; R-68-N0-2) CFSTI: HC $3.00/MF $0.65

A description is given of how maximum electric intensity can be determined analytically for the field between two parallel conductors. Analytical results are presented as curves that relate the electric field at the wire surface to a function of wire size and spacing. Various size wires, which had been embedded in Hysol 13-009 epoxy resin, were used to determine breakdown voltage. When relating breakdown voltage to field intensity at the wire surface, all samples tested broke down at a characteristic intensity of approximately 9.9 kv/mil. The calculated maximum field intensity can therefore be used as a design tool in determining optimum wire spacings and maximum allowable voltages. Author (NSA)

N68-24943 Ohio State Univ., Columbus.
MAGNETIC COMPRESSION OF AXIALLY SYMMETRIC BRILLOUIN-FOCUSED ELECTRON BEAMS
John Alan Seeger (Ph.D. Thesis) 1966 108 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-2532

A detailed study has been made of magnetic compression of high current density, Brillouin-focused electron beams, beginning with the equations of motion for beam electrons. Analysis of beam compression in the magnetic field build-up region was by the numerical calculation of electron trajectories using a rectangular array of equivalent potentials representing the combined electrostatic and magnetic fields. Electrostatic field data were measured with a resistance network analog designed for axially symmetric problems. The effect of the magnetic field was calculated as a potential and combined with the electrostatic potential at each point in the array to obtain the equivalent potential. The trajectory tracing equations were programmed for use with the IBM 7094 computer. Dissert. Abstr.

N68-24980 Michigan Univ., Ann Arbor.
ON THE HELMHOLTZ EQUATION FOR AN ACOUSTICALLY RIGID SCATTERER
Ergun Ar (Ph.D. Thesis) 1966 60 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-1705

The three-dimensional scalar wave function for a smooth, acoustically hard scatterer is generated from the potential Green's function of the second kind for the same scatterer. This is achieved by first reducing the problem to that of solving the operator equation $u = L \circ u + u^{(i)}$, where $u^{(i)}$ is a known function, L is an integro-differential operator (operating over the exterior volume and the surface of the scatterer) whose kernel contains the static Green's function of the second kind for the surface of the scatterer. Then, in a proper normed linear space, the solution of this equation is found in the form of a Neumann–Liouville series for wave numbers with sufficiently small modulus. As an example the procedure is applied to a spherical scatterer. Dissert. Abstr.

N68-24984# Brookhaven National Lab., Upton, N. Y.
TRANSIENT BEAM LOADING IN STANDING WAVE LINACS
M. J. Lee 5 Feb. 1968 14 p refs
(BNL-12231) CFSTI: HC $3.00/MF $0.65

The amplitude of the beam-induced field in standing wave linacs, taking into account the changes in the beam velocity and cavity cell length, is calculated. NSA

N68-25034 Catholic Univ. of America, Washington, D. C.
ANALYSIS OF POLYDISPERSE PARTICLE ENSEMBLES BY LIGHT SCATTERING TECHNIQUES
Robert Stephen Powell (Ph.D. Thesis) 1966 85 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-1490

A mathematical method is presented whereby the size distribution and refractive index of polydisperse particles can be deduced rather easily from light scattering measurements. The general optical properties of polydisperse particle ensembles are described. Graphs are presented which may be used to replace the voluminous tabulations from the Mie Theory when the particles in question are sufficiently polydisperse. The polarization and angular distribution of light scattered by suspensions containing zinc oxide fourlings or magnesium oxide cubes was compared to that expected from spherical particles. The randomly aligned, irregular particles scatter almost like spheres in the angular range $60° < \theta < 150°$. Scattering measurements in this range cannot be used to deduce the shapes of randomly aligned particles. Measurements of the scattered continuum from comet Arend–Roland are analyzed. Dissert. Abstr.

N68-25038 Texas Univ., Austin.
THE VELOCITY OF ULTRASOUND IN LITHIUM–AMMONIA SOLUTIONS
Donald Edgar Bowen (Ph.D. Thesis) 1966 103 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-3252

The velocity of 10 mc sound waves in lithium–ammonia solutions has been determined as a function of temperature and metal concentration for temperatures between 89°K and 240°K and for concentrations between 0.0 mole percent (pure NH_3) and 20.0 mole percent (saturation). The lithium–ammonia solutions were contained in cylindrical quartz cells. The sound energy was propagated along the cylinder axis by means of X-cut quartz crystal transducers cemented to the outside of the cell. The transducers were excited by means of a pulse modulated 10 mc wave. The pulse width was 1.5 microseconds. The velocities were obtained by measuring the time between reflected pulses using the delayed sweep of an oscilloscope. The sound velocity is a linear function of the temperature for temperatures such that the solutions are not in the mixed phase region. Dissert. Abstr.

N68-25066 Michigan Univ., Ann Arbor.
THE RESPONSE OF A NONLINEAR TWO DEGREE OF FREEDOM SYSTEM
Thomas Barker Hoekstra (Ph.D. Thesis) 1966 68 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-1755

The response of a two degree of freedom system made up of a (base) mass–spring–damper excited in one direction by the rotation of an eccentric mass is analyzed as a function of an external torque applied to the eccentric mass. The motion of the base mass is considered to be sinusoidal and at the same frequency as the rotational motion of the eccentric mass. Considering the sinusoidal motion to be of known amplitude and frequency, considerable preliminary information is obtained for this system which is essentially a rotating pendulum whose support point is moving in one direction sinusoidally. It is found that transients in the applied torque cause harmonic oscillations in the angular velocity whose frequency depends on the amplitude of the base mass motion. It is found that when the motion of the base mass is sufficiently large, true steady state motion cannot be realized. A limit is also found to the range of torque values for which steady state motion is predicted. Dissert. Abstr.

N68-25111 Pennsylvania Univ., Philadelphia.
RADIATION FROM A LINE SOURCE OVER AN INHOMOGENEOUS IMPEDANCE PLANE
Sundaram Chidambaram Moorthy (Ph.D. Thesis) 1966 133 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-3095

The impedance plane considered is an infinite plane surface $y = 0$ (the coordinate system chosen is a rectangular cartesian system XYZ) and the impedance of this surface varies in the X direction according to the relation, $Z(x) = ax/i\omega\epsilon(x^2 + \lambda^2)$ where a and λ are real numbers which govern the nature of the impedance variation and ϵ is the permittivity of the linear homogeneous isotropic medium above the impedance plane. The impedance is purely capacitive for $x > 0$ and purely inductive for $x < 0$ (assumed time factor being $e^{j\omega t}$). The fields are generated by a magnetic line current located on the y axis at a certain height above the impedance plane. When λ is extremely small and the line source located very close to the impedance plane, the radiation pattern is highly directive and points towards the region of inductive impedance. This is explained as being caused by a strong coupling of the energy to the inductive side in the form of surface waves which radiate gradually as they move outward. Dissert. Abstr.

N68-25114 Michigan Univ., Ann Arbor.
THEORETICAL AND EXPERIMENTAL STUDY OF THE SCATTERING BEHAVIOR OF A CIRCUMFERENTIALLY-LOADED SPHERE
Valdis Vincents Liepa (Ph.D. Thesis) 1966 120 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-1770

The electromagnetic scattering behavior of a metallic sphere loaded with a circumferential slot in a plane perpendicular to the direction of incidence is investigated. The slot is assumed to be of small non-zero width with a constant electric field across it and with an asymmetric variation in the azimuthal direction. The numerical study is restricted to the frequency range corresponding to $0 < ka \leq 10.0$, and the computed results are presented primarily for passive loading. The maximum and minimum back scattering cross sections and the corresponding loading needed to attain these values are presented. Experimental data, obtained using a metallic sphere with an equatorial slot backed by a radial cavity of adjustable depth, is presented for the surface field and back scattering measurements. The results are compared with the computed values and the agreement is excellent. Dissert. Abstr.

N68-25154# Brookhaven National Lab., Upton, N. Y. Accelerator Dept.
THEORY AND DESIGN OF BEAM TRANSPORT SYSTEMS
B. A. Norman and W. H. Moore 1 Sep. 1967 233 p refs
(BNL-12138) CFSTI: HC $3.00/MF $0.65

A detailed analysis is presented in an effort to provide reasonably accurate input data for convergent beam programs. An investigation of the problem of transporting an emittance ellipse from one accelerator into an acceptance ellipse by a following accelerator is described. Beam transport systems considered are limited to those through which singly-charged beam particles pass only once and are not accelerated longitudinally. Linear optics is applied to all problems. Quadrupoles are replaced by thin lenses and their effective lengths added to the drift space. Nondispersive systems and dispersive systems with homogeneous field sector magnets are examined. Beam transport programs are described

which calculate the optical parameters after convergence in terms of matrix elements and also plot the phase ellipses. Also, transverse space-charge effects are examined. NSA

N68-25232 Ohio State Univ., Columbus.
THE SCATTERING BY A TWO-DIMENSIONAL PERIODIC ARRAY OF PLATES
Randolph Harvey Ott (Ph.D. Thesis) 1966 114 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-2509

A plane wave is normally incident on a two-dimensional periodic array of vanishingly thin, perfectly conducting, narrow, rectangular plates. Using a dyadic Green's function, an integral representation of the electric field is obtained in terms of the current density on the plates. The boundary condition on the electric field is enforced at N points on each plate. This yields N linear inhomogeneous equations for the N unknown coefficients in the expansion of the current density. A gauge is defined which enables one to find a set of boundary points resulting in a least error in the reflection coefficient. Close agreement is obtained between resonance curves calculated from this solution and the corresponding measured curves. The effects of higher order propagation modes on the boundary-value solution are considered, with specific attention being given to the Wood's anomalies. Dissert. Abstr.

N68-25321# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
DESIGN AND CONSTRUCTION OF A FARADAY CUP FOR MEASURING SMALL ELECTRON CURRENTS [ETUDES ET REALIZATION D'UNE COUPE CE FARADAY POUR LES MESURES DE FAIBLES COURANTS ELECTRONIQUES]
Andre Veyssiere Oct. 1967 28 p refs In FRENCH
(CEA-R-3276)

The design of a device for measuring and integrating very small currents generated by the impact of a charged particle beam upon a Faraday cut is described. The main component is a graphite bloc capable of stopping practically all the incident changes. The associated electronic apparatus required to measure better than 10 −13 ampere with a precision of 1 per cent is also described. Author (NSA)

N68-25369*# Houston Univ., Tex. Dept. of Physics.
SPACE RELATED SCIENTIFIC AND TECHNICAL INVESTIGATIONS Final Progress Report, 1 Sep. 1967–29 Feb. 1968
John W. Kern May 1968 44 p refs
(Grant NGR-44-005-022)
(NASA-CR-94778) CFSTI: HC $3.00/MF $0.65 CSCL 20

Research results are described in the following areas: (1) low temperature physics, (2) solid state physics, (3) atomic physics, (4) comet physics, and (5) physics of space related flow problems. The research projects are concerned with second sound in a moving coordinate system, pressure measurements in a superfluid helium flow (the complete study is attached), quantization of vortices in simply and doubly connected superfluid regions, acoustic properties of metals using magnetoacoustic techniques, spin dependent atomic collisions, perturbations in an electron gas, metallic lattice dispersion relations, low temperature thermal properties of rotating crystals, optical pumping of the D line ratio of Comet 1962 III, cometary plasmas and the solar wind, atmospheric refraction and the Gegenschein, applications of differential forms, computer techniques, nonlinear source terms in electrodynamics, and solar wind termination and the interstellar medium. R.N.A.

N68-25378 Washington Univ., Seattle.
RANDOM VIBRATIONS IN DISCRETE NONLINEAR DYNAMIC SYSTEMS
Ram Gopal Bhandari (Ph.D. Thesis) 1966 110 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-2142

A one-degree-of-freedom system and a two-degree-of-freedom system containing displacement and velocity dependent nonlinearities under stationary Gaussian white noise excitation have been studied by the method of the Fokker–Planck equation. Nonlinearities have been represented by suitable polynomials. The Fokker–Planck equations governing the stationary probability density function for these systems have been solved by representing the density function with a multiple series of Hermite polynomials. The constants in the series expansion were determined by Galerkin's method. Examples of the systems containing cubical nonlinearities in velocity and displacement dependent forces were studied by the series method. Comparisons were made between series and exact solutions for those special cases for which exact solutions are known. The results are found to be in good agreement. Dissert. Abstr.

N68-25401# United Kingdom Atomic Energy Authority, Culham (England). Translation Office.
ALIGNMENT OF THE MAGNETIC SYSTEM IN "SIRIUS"
P. Ya. Burchenko, B. T. Vasilenko, E. D. Volkov, R. M. Nikolaev, V. P. Sebko et al Oct. 1967 3 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 23, Aug. 1967 p 135
(NP-TR-1632; CTO-435) CFSTI: HC $3.00/MF $0.65

The experiments were carried out using a technique based on the repeated passage of a low-energy electron beam. The shape of the magnetic surfaces was investigated on the straight section of the racetrack. NSA

N68-25491# National Inst. for Research in Nuclear Science, Harwell (England). Rutherford High Energy Lab.
CONTROL OF THE R.F. IN A PROTON SYNCHROTRON WITH BEAM LOADING
G. H. Rees Jan. 1968 13 p refs
(RHEL/R-158) HMSO: 2s 6d

Control of the rf in a beam loaded proton synchrotron involves four coupled control loops. A computer program was written to evaluate the transfer functions of these interacting loops. Author (NSA)

N68-25496 National Bureau of Standards, Washington, D. C.
STANDARD METHODS FOR SOUND INSULATION AND ITS MEASUREMENT
Richard K. Cook 26 Sep. 1966 17 p refs Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C5/P4)

Standard methods of determining specified amounts of sound insulation required for homes and buildings in the vicinity of airports are presented. Insulation requirements are determined by use of a physical system of measurements consisting essentially of microphones, amplifiers, and an indicating meter. It is pointed out that a knowledge of how the transmission loss of a wall varies with frequency, together with frequency distribution of the noise to be insulated, is essential for scientific noise control. Standard laboratory methods of measuring airborne sound transmission loss, and their application to actual building measurements, are outlined. A summary of results of measurements on a few sound insulating constructions which might be useful for buildings near airports are given. A.L.

N68-25519# Royal Aircraft Establishment, Farnborough (England).
PROPOSED TERMS FOR DESCRIBING SOME PROPERTIES OF PHYSICAL SYSTEMS
H. R. Hopkin and H. H. B. M. Thomas Jul. 1967 81 p refs
(RAE-TM-AERO-997) CFSTI: HC $3.00/MF $0.65

A recent R.A.E. Memorandum gave a restricted list of terms and definitions, mainly for people concerned with aircraft dynamics and in particular with vibrations. This paper suggests modifications in some definitions so as to extend them to physical systems in general, and alternative terms and new terms are proposed for the same reason. Where other reasons led to a change of definition these are discussed. Other efforts at R.A.E., and also within the International Standards Organisation, on notation and nomenclature for aircraft dynamics have been kept in mind. Author

N68-25564# National Standards Lab., Sydney (Australia).
METHOD OF MEASURING VIBRATORY DISPLACEMENTS IN TERMS OF A LIGHT WAVELENGTH
J. L. Goldberg *In* NRL The Shock and Vibration Bull., No. 37, Pt. 2 Jan. 1968 p 13–16 refs (See N68-25561 14-32)

A method of determining the peak-to-peak displacement of a sinusoidal vibration in terms of the wavelength of light is described. The interferometer used is of the Fizeau multiple-beam type in which the silvered adjacent surfaces of the optical flats act as the two electrodes of a capacitor, in addition to performing their function in the interferometer. The two electrodes are surrounded by a third or guard electrode so that the capacitance change between the silvered films which occurs when one of the optical flats is moved can be measured by comparison with a standard three-terminal capacitor in a transformer bridge. The sinusoidal motion is imparted to one surface of the interferometer and the capacitance change recorded on a direct-writing oscillograph. This capacitance change is then calibrated by slowly moving the surface of the interferometer in a rectilinear manner and recording by a photoelectric detector the passage of interference fringes past a slit aperture in the optical field. The chart is thus calibrated in terms of interference fringes and the peak-to-peak displacement of the motion is readily determined. An example of an oscillatory motion measured by this method is presented. Author

N68-25627# Lockheed Missiles and Space Co., Palo Alto, Calif.
DETERMINATION OF ENERGY DISSIPATION DURING PLASTIC DEFORMATION
T. I. Glebov and A. A. Kulishov [1967] 4 p refs Transl. into ENGLISH from Samoletstr. i Tekhn. Vozd. Flota (Kharkov), no. 10, 1967 p 91–94

The energy dissipation function $E_i = \sigma_i \epsilon_i$ where ϵ_i is the strain rate intensity and σ_i the stress intensity is expanded integrally to express metal deformation. Example calculations are given for the forming process of an angle bracket by constraint bending. This constraint bending is accomplished by forced plastic deformation of a plane sheet billet in closed stamps. G.G.

N68-25633# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
THE SEMINAR AT THE PHYSICS LABORATORY DURING THE PERIOD MAY–AUGUST, 1967 [IL SEMINARIO DEI LABORATORI DI FISICA NEL QUADRIMESTRE MAGGIO–AGOSTO 1967]
14 Sep. 1967 60 p refs In ITALIAN; ENGLISH summary
(ISS-67/30) CFSTI: HC $3.00/MF $0.65

This report presents a synopsis of the lectures held at the Physics Laboratory of the Istituto Superiore di Sanita during the period May–August 1967. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N68-24363# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Energeticheskii Institut.
RADIATIVE NEUTRON CAPTURE IN THE SYNTHESIS OF HEAVY NUCLEI [RADIATSIONNYI ZAKHVAT NEITRONOV PRI SINTEZE TYAZHELYKH ELEMENTOV]
V. S. Shorin, S. P. Kapchigashev, and V. E. Kolesov 1968 30 p refs In RUSSIAN
(FEI-64)

The models of S- and r-processes of element formation in the stars are considered. New experimental data from the literature on the radiative neutron capture cross sections for separated isotopes, cross sections calculated from the statistical theory of nuclear reactions, and data on the chemical composition of meteorites have been used to derive the values of $N_s\sigma_{n,\gamma}$ for the nuclei formed in the pure S-process. The results obtained are 2 to 3 times lower than those proposed earlier, and have confirmed a smooth dependence of the function N on the atomic weight. The contribution of the S- and r-processes to the absolute abundance of heavy nuclei formed in the mixed capture (^{88}Sr–^{203}Tl) have been calculated on the basis of the $N_s\sigma_{n,\gamma} = f(A)$ graph. NSA

N68-24365# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
NOTE ON X-RAY SCATTERING BY ARGON
Dominique Levesque and Loup Verlet Mar. 1968 3 p refs
(TH/68/9) CFSTI: HC $3.00/MF $0.65

The structure factor measured by X-ray scattering experiments on Argon is compared with the same quantities calculated with two different intermolecular potentials. It is shown that it is not possible to get quantitative information concerning the interaction from the scattering data, and that the discrepancy between theory and experiment is probably due to a systematic error in the latter. Author

N68-24370* New York Univ., N. Y. Chemistry Dept.
THEORETICAL STUDY OF THE ATOMIC AND MOLECULAR GASES AND THEIR REACTIONS IN THE UPPER ATMOSPHERE Summary Report, 1 Nov. 1967–30 Apr. 1968
Roop C. Sahni 30 Apr. 1968 10 p
(Grant NsG-76-60)
(NASA-CR-94685) CSCL 20H

Programs were developed for the quantum mechanical treatment of doubly excited states of nitrogen and carbon monoxide molecules; and work was completed on configuration interaction treatment for the improvement of the wave functions and potential energy curves of LiH and BH. The RKR Franck–Condon factors for the gamma and beta band systems of the NO molecule were studied, with the major effort on these diatomic molecules consisting of determining the potential energy curves and calculating their molecular constants to ascertain their accuracy. It is noted that the doubly excited states, while not observed by ordinary spectroscopic investigations, should be observed by sources of monochromatic radiation such as lasers. Electron configurations are tabulated for the different states of N_2, and total energies of these states are calculated from optimized coefficients of the ground state using an extended set of atomic orbitals. Vertical excitation energies of both the singly and doubly excited states of CO and N_2 were found by direct calculation and by Koopmans' treatment. M.W.R.

N68-24379# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
THE CONSEQUENCES OF THE CPT-INVARIANCE AND AN EXPERIMENT [SLEDSTVIYA CPT-INVARIANTNOSTI I EKSPERIMENT]
L. I. Lapidus 1968 23 p refs In RUSSIAN Submitted for publication
(JINR-P2-3668)

A review is presented of the state of the CPT-invariance testing. The conclusions of the CPT-invariance on the mass equality, the lifetimes and magnetic moments of particles and their antiparticles are repeated. Experimental data for various particles are given. An expression for the $K+ \rightarrow \pi^+\pi^0$ decay amplitudes is obtained in the absence of the CPT-invariance. It is stressed that the phase relation (30) is sensitive to the possible deviations from the CPT-invariance. Author (NSA)

N68-24384# Atomics International, Canoga Park, Calif.
INFLUENCE OF NUCLEAR DEFORMATION ON NEUTRON WAVE STRENGTH FUNCTIONS OF HEAVY EVEN–EVEN ROTOR NUCLIDES
G. Gigas 1 Oct. 1967 16 p refs
(Contract AT(04-3)-701)
(NAA-SR-MEMO-12538) CFSTI: HC $3.00/MF $0.65

The neutron s-, p-, and d-wave strength functions for 15 heavy even-even rotor nuclides from ^{226}Ra to ^{244}Cm were calculated with a deformed nucleus optical model using the deformations of Stelson and Grodzins. Repetition of the analyses with reduced deformations, as suggested by considerations of the multipole moments of diffuse-edged charge distributions and the potential scattering radius data, produced an improved agreement with experimental measurements. The reduced deformations were essentially equivalent to the ground-state equilibrium deformations calculated from the BCS theory using projected wave functions including an explicit Coulomb term. Comparative analyses with a single-particle vibrator model, as well as a spherical nucleus with a diffuse edge, are presented. Author (NSA)

N68-24385# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf.
INVESTIGATION OF THE PROMPT γ RAYS OF THE FISSION FRAGMENTS ON SPONTANEOUS FISSION OF Cf-252 [UNTERSUCHUNG DER PROMPTEN γ-STRAHLUNG DER SPALTFRAGMENTE BEI DER SPONTANEN SPALTUNG VON Cf-252]
H. P. Axmann and E. Ujlaki 1967 11 p refs In GERMAN
(SGAE-PH-59/1967)

A Ge(Li) detector was used for the analysis of the low-energy prompt γ radiation (100 to 300 keV) of the fragments originating from the spontaneous fission of ^{252}Cf. The fission-fragment spectra were detected by means of Si(Au) surface-barrier detectors. The fission-fragment pulses gated the spectrum recorded in the γ-ray detector. Measurements in two different geometries produced very well structured γ spectra and permitted a rough estimation of the emission time of particular γ lines. Author (NSA)

N68-24424# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON THE ACCOUNT OF ELECTROMAGNETIC EFFECTS AND DISPERSION RELATIONS FOR THE FORWARD SCATTERING [OB UCHETE ELEKTROMAGNITNYKH EFFEKTOV V DISPERSIONNYKH SOOT NOSHENIYAKH DLYA RASSEYANIYA VPERED]
L. D. Solov'ev and A. V. Shchelkachev 1968 18 p refs In RUSSIAN Submitted for publication
(JINR-P2-3670)

The dispersion relations for the pion-nucleon forward scattering are written down taking into account the electromagnetic corrections. It is shown that these corrections need be considered while comparing the dispersion relations with the experimental data at high energies. Some theoretical models, used for finding the purely nuclear amplitude from the experiment, are discussed. Author (NSA)

N68-24457# European Atomic Energy Community, Geel (Belgium).
MEASUREMENTS OF NEUTRON SCATTERING FROM ^7Li
H.-H. Knitter and M. Coppola Brussels Mar. 1968 22 p refs
(EUR-3903.E) CFSTI: HC $3.00/MF $0.65

Angular distributions of neutrons elastically and inelastically scattered by ^7Li were measured at eight incoming energies between 1.12 and 2.30 MeV, using a fast neutron time-of-flight spectrometer. Data were corrected for flux attenuation and multiple scattering in the sample and for effects due to finite geometry. Differential cross section results are expressed in the form of Legendre polynomial expansions. Evaluated total and total inelastic cross sections are presented. Author

N68-24475# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
INVESTIGATION OF THE REACTION $\pi^- + p \rightarrow \pi^- + \pi^+ + n + \pi^0 + \pi^0$ AT 4 GeV/c π^- MESONS [ISSLEDOVANIE REAKTSII $\pi^- + p \rightarrow \pi^- + \pi^+ + n + \pi^0 + \pi^0$ PRI IMPUL'SE π^- MEZONOV 4 GeV/C]
V. G. Grishin, K. G. Bulyamov, D. K. Kopylova, D. K. Muminov, Z. Trka et al 1968 23 p refs In RUSSIAN
(JINR-P1-3677)

The reaction $\pi^- + p \rightarrow n + \pi^+ + \pi^- + \pi^0 + \pi^0$ at pC = 4 GeV was investigated using a 24-liter propane bubble chamber. Average weights of the events with γ-quanta were introduced. A narrow peak was obtained in the effective mass $M(\gamma\gamma)$ in the region of π^0-mesons with a half-width equal to ±7%. The reaction cross section turned out to be $\sigma(2\pi^0) = (3.4 \pm 0.6)$ mb. The spectra of effective and missing masses were studied. The data are obtained indicating a possible production of the isobar $N^* \rightarrow n + \pi^0\pi^0$ with $M(N^*) \geq 2$ GeV. Author (NSA)

N68-24485# California Univ., Santa Cruz. Natural Sciences Div.
K_{e4} DECAY AND π–π SCATTERING.
Alexander Maksymowicz Sep. 1967 9 p refs Seminar Presented at IX Latin Am. School of Phys., Santiago, Chile, 1967 Sponsored in Part by NSF
(Contract AT(30-1)-3829)
(NYO-3829-14) CFSTI: HC $3.00/MF $0.65

A discussion is given of previous work on K_{e4} decay, which was proposed as a suitable process for determining the parameters of the $\pi + \pi$ interaction. Special attention is given to the assumptions involved, and restriction is made to the decay mode $K+ \rightarrow \pi^+ + \pi^- + e^+ + \nu$. NSA

N68-24513 Tokyo Univ. of Education (Japan). Dept. of Physics.
SYMMETRIC TENSOR CURRENTS AND SYMMETRIC AXIAL TENSOR CURRENTS
Chiaki Itoh [1968] 14 p refs
(TUEP-68-4) CFSTI: $3.00

If chiral SU(3) × SU(3) symmetry is an exact symmetry for spin 2 fields, we may expect $J^{PC} = 2^{--}$ nonet may exist with the same mass as the $J^{PC} = 2^{++}$ nonet. We propose $J^{PC} = 2^{++}$ and $J^{PC} = 2^{--}$ nenet mesons to couple to the symmetric tensor currents $T_{(\mu\nu)}$ and symmetric axial tensor currents $T_{(\mu\nu)}$ where i = 0, 1, ... 8 is the unitary spin suffix and μ and ν are Lorentz suffices. $T_{(\mu\nu)}$ is the minimal derivative part of the stress-energy-momentum tensor. $T_{(\mu\nu)}$ is it's generalization with a unitary spin suffix and $T_{(\mu\nu)}$ is of the other parity. We discuss the problems in a quark model. To symmetrize the currents, we introduce the space integrals Q_ν and Q_ν of the fourth components of the other Lorentz index of the tensor and axial tensor currents. Q_ν is the energy-momentum four vector and equals to P_ν but it's generalizations Q_ν and Q^{5i} do not coincide with P_ν and P^{5i}. Four divergences of the tensor and axial tensor currents are given. Equal time commutators of one of P_a and P^{5i} and one of F^i, F^{5i} P^i and P^{5i} are given, where a = 1, 2 and 3. Author

N68-24589# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

CLASSIC AND QUANTUM S-MATRIX IN THE TWO-DIMENSIONAL BORN-INFELD MODEL [KLASSICHESKAYA I KVANTOVAYA S-MATRITSA V DVUKHMERNOI MODELI POLYA BORNAINFEL'DA]

B. M. Barbashov 1968 22 p In RUSSIAN
(JINR-P2-3662)

A method of determining the S-matrix for the nonlinear Born–Infeld field is considered in two-dimensional space x,t. The classic S-matrix, which converts the incident waves into the outgoing ones, is determined on the basis of an exact solution of the classic equation of this field. It is shown that in a certain approximation on the "nonlinearity" parameter the g-quantum S-matrix coincides with the "classic" one. In this approximation the S-matrix leads only to the elastic scattering processes. Author (NSA)

N68-24601# Joint Inst. for Nuclear Research, Dubna (USSR). Lab of Theoretical Physics.

SOME EXPERIMENTAL CONSEQUENCES OF THE ANALYTICITY OF THE FORM FACTOR

Nguyen van Hieu 1968 9 p refs Submitted for publication
(JINR-E2-3729)

On the basis of the analyticity of the form factor the connection between its behavior in the physical regions of the scattering and annihilation channels are studied. Also some lower bound for the form factor in the annihilation channel is established. Author (NSA)

N68-24604# Joint Publications Research Service, Washington, D. C.

HIGH ENERGY PHYSICS

A. M. Baldin, V. P. Dzhelepov, V. P. Zrelov, L. I. Lapidus, L. B. Okun et al *In its* Soviet Atomic Sci. and Eng. 13 May 1968 p 196–236 (See N68-24602 14-22)

The theoretical contributions of Soviet scientists in the area of high energy physics are reviewed. Particular emphasis is placed on the research being conducted on the strong interactions of elementary particles, including strong interactions at high energies, theory of reactions near the threshold, and symmetry of strong interaction; weak interactions of elementary particles, lepton and nonlepton decay, nonconservation of parity, uneven nuclear forces, isotopic and unitary selection rules, and disruption of CP-invariants; and electromagnetic interactions. The theory of Vavilov–Cerenkov radiation for relativistic particles is cited as an outstanding contribution. Consideration is also given to the general problems of quantum field theory, and the use of quarks in phenomenological constructions. Recommendations on future research are proposed. M.G.J.

N68-24607# Joint Publications Research Service, Washington, D. C.

METHODS OF SYNTHESIS AND PROPERTIES OF THE TRANSURANIUM ELEMENTS

G. N. Flerov and V. A. Druin *In its* Soviet Atomic Sci. and Eng. 13 May 1968 p 252–269 (See N68-24602 14-22)

The difficulties inherent in various methods of synthesizing transuranium elements are discussed, and the work of Soviet scientists in this area are reviewed. Emphasis is placed on the experiments which resulted in the detection of mendelevium (element 101); element 102, and the properties of its short-lived isotopes; lawrencium (element 103), and the alpha-active isotopes which occur in the nuclear reactions; and element 104. For the production of element 104, the nuclear reaction $Pu^{242}(Ne^{22},4N)104^{260}$ was selected, and the experiments were conducted on the internal beam of the 310-cm cyclotron. The extremely rigid requirements placed on the physical apparatus used are described. Techniques for studying the chemical properties of element 104 are discussed, and the data obtained show that element 104 is not an actinide but belongs to group 4 of the periodic table. The possibilities of synthesizing elements 105 and 106 are assessed. M.G.J.

N68-24612# Joint Publications Research Service, Washington, D. C.

RADIATION ENGINEERING

G. I. Kir'yanov, I. I. Kreyndlin, N. I. Leshchinskiy, S. V. Mamikonyam, V. B. Osipov et al *In its* Soviet Atomic Sci. and Eng. 13 May 1968 p 425–454 refs (See N68-24602 14-22)

The areas of science, technology, medicine, and agriculture, in which radiation methods and radiation engineering are applied, are surveyed. The development of low power autonomous sources of thermal and electrical energy, based on the use of radioactive isotopes, is reviewed, and it is pointed out that these isotope sources are characterized by design simplicity, high reliability, long service life, and ability to operate without servicing by man. Expanded radiochemical and radiobiological research activities are discussed in terms of the creation of powerful sources of ionizing radiation based on the use of the radioactive isotopes Co^{60}, Cs^{137}, charged particle accelerators, fuel elements, and the radiation circuits of nuclear reactors. Soviet large scale series production of five types of radioisotope apparatus is discussed, along with physical methods for radioisotope instrument building. M.G.J.

N68-24822# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.

CONICAL AND PLANE SURFACE SCATTERING: Program SURF

J. E. MacDonald Feb. 1968 60 p
(GEMP-582) CFSTI: HC $3.00/MF $0.65

Program SURF, GE-NMPO program NMP-854, calculates neutron and gamma-ray dose rates and flux distributions in energy at unshielded receiver points due to direct beam and once-scattered radiation from anisotropic point sources. Only one scattering structure with either conic or slab geometry is allowed. Attenuation of radiation in the scattering structure is neglected. The program was written in Fortran IV for the GE-625 requiring 32K fast memory. No tapes, drums, or disks are required apart from the system input and output tapes. The program is in production status. Author (NSA)

N68-24631# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

DESER–HILBERT–SUDERSHAN SPECTRAL REPRESENTATION AND MATRIX ELEMENTS OF EQUAL TIME CURRENT–CURRENT COMMUTATORS IN THE PERTURBATION THEORY [SPEKTRAL'NOE PREDSTAVLENIE DEZERA–GIL'BERTA–SUDARSHANA I MATRICHNYE ELEMENTY KOMMUTATOROV TOKOV PRI RAVNYKH VREMENAKH V TEORII VOZMUSHCHENII]

N. I. Usyukina 1968 17 p refs In RUSSIAN
(JINR-P2-3661)

Deser–Hilbert–Sudershan spectral representation for the matrix element $\langle p|[j_\alpha(x/2)j_\beta(-x/2)]|0\rangle$ in the lowest order of the perturbation theory for renormalizable quark model with bare Lagrangian of interaction $L_{int}(x) = g_\varepsilon \bar{\psi}(x)\psi(x)\phi_\varepsilon(x) + ig_p \bar{\psi}(x)\gamma^5\psi(x)\phi_p(x) + g_\gamma \bar{\psi}(x)\lambda_\alpha\psi(x)a_\gamma(x)$, is considered. The value of the matrix element $\langle p|[j_\alpha(x/2)j_\beta(x/2)]|0\rangle$ is considered for equal times on the basis of this representation. Author (NSA)

N68-24639# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

UNAMBIGUOUS PHASE SHIFT ANALYSIS OF NUCLEON–NUCLEON SCATTERING AT 400 MEV AND THE ENERGY DEPENDENCE OF PHASE SHIFTS ABOVE THE PION PRODUCTION THRESHOLD

Z. Yanout, Yu. M. Kazarinov, F. Legar, and A. M. Rozanova 1968 34 p refs
(JINR-E1-3707)

The phase shift analysis of nucleon–nucleon scattering data at energies near 400 MeV was performed. The search for the solutions of the phase shifts was carried out for $L_{max}=4$. Only the D_2 wave is assumed to have an imaginary part. Seven solutions were obtained in the region $\chi^2 \leq 1.5\chi^{-2}$. A detailed investigation has shown, that six of them can be rejected with the probability of Type I error smaller than 0.59%. Tables of phase shifts and the angular dependences of the experimental quantities are given. The energy dependences of phase shifts in the region 10 to 630 MeV are shown in the graphs. Author (NSA)

N68-24642# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.

MULTIPOLARITY OF THE TRANSITION WITH 341 KEV ENERGY ACCOMPANYING THE CAPTURE OF THERMAL NEUTRONS BY Ti^{48} [MUL'TINOL'NOST PEREKHODA S ENERGIEI 341 KEV, SOPROVOZHDAYUSHCHEGO ZAKHVAT TEPLOVYKH NEITRONOV Ti^{48}]

E. F. Tret'yakov, G. V. Danilyan, V. S. Pavlov, G. I. Grishuk, and V. F. Konyaev 1967 16 p refs In RUSSIAN; ENGLISH summary
(ITEF-52)

The internal conversion coefficient of the 341-keV transition accompanying the capture of thermal neutrons by ^{48}Ti was measured. The value $\alpha = 0.95 \pm 0.14 \times 10^{-3}$ obtained within the errors coincides with the table value of α for an M1 transition. This result, together with the data available on the angular correlation measurements allows one to make a choice between two possible values of the mixing parameter $\delta = +2.2$ or $\delta = -0.1$ in the favor of the latter one. In the control experiments intended to test the ICC absolute measurement method, the internal conversion coefficient for the 323-keV transition in ^{51}V $\alpha = 1.45 \pm 0.14 \times 10^{-3}$ as well as the intensity of the 341-keV transition in ^{49}Ti per neutron captured, $\nu = 0.33 \pm 0.08$ were determined. Author (NSA)

N68-24645# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

ELASTIC N-N SCATTERING AMPLITUDES IN THE STATES WITH THE T=0 AND T=1 ISOTOPIC SPINS [AMPLITUDY UPRUGOGO NN- RASSEYANIYA V SOSTOYANIYAKH S IZOTOPICHESKIM SPINOM T=0 I T=1]

B. M. Golovin and A. M. Rozanova 1968 29 p refs In RUSSIAN
(JINR-P1-3702)

The amplitudes of the elastic nucleon-nucleon scattering in the states with T=0 and T=1 isotopic spins were calculated for a number of energies in the region 23 to 630 MeV. The calculations were made according to the data of the previously published phase shift analysis. Author (NSA)

N68-24647# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.

RELATIVISTIC-INVARIANT MODELS OF BARYONS REGARDED AS COMPOSITE PARTICLES

V. P. Shelest 1967 32 p refs
(ITF-67-47)

The relativistic matrix elements of baryon currents are determined in the framework of the quasi-independent quark model. The existence of an algebra of these matrix elements taken to first order in the inverse matrix of the baryon is demonstrated. Author (NSA)

N68-24648# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

A LOWER BOUND OF THE ELASTIC SCATTERING AMPLITUDE AT FIXED MOMENTUM TRANSFER

Nguyen van Hieu 1968 5 p refs
(JINR-E2-3728)

A lower bound of the cross section decrease is obtained in the physical region $t < 0$ on the basis of the analytic properties of the scattering amplitude. Author (NSA)

N68-24649# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

SOME PROBLEMS CONNECTED WITH NUCLEAR STRUCTURE AND NEUTRON INDUCED REACTIONS [ZAGADNIENIA STRUKTURY JADER ATOMOWYCH I REAKCJI JADROWYCH WYWOLANYCH PRZEZ NEUTRONY]

J. Turkiewicz 1967 57 p refs In POLISH; ENGLISH summary
(INR-830/I/PL)

Several aspects of the energy dependence of the cross sections for fast neutron-induced reactions as well as some problems of the cluster structure of nuclear surface are presented. Author (NSA)

N68-24650# Virginia Univ., Charlottesville.

ELASTIC SCATTERING OF FAST NEUTRONS BY PRASEODYMIUM AND LANTHANUM

D. L. Bernard, G. H. Lenz, and J. D. Reber [1967] 11 p refs Presented at 2d Conf. on Neutron Cross Sect. and Technol., Washington, D. C., 4–7 Mar. 1968
(CONF-680307-13) CFSTI: HC $3.00/MF $0.65

The differential cross section for the elastic scattering of fast neutrons by praseodymium and lanthanum was measured for an incident neutron energy of 8.00 MeV from 25 to 155° in the laboratory system. A pulsed-beam neutron time-of-flight spectrometer was used in conjunction with a Mobley buncher and a 12.7-cm diameter NE102 plastic scintillator. The absolute differential cross section was normalized to the n-p differential cross section at 40° in the laboratory system. Author (NSA)

N68-24657*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.

ENERGY REQUIRED FOR PROTON PRODUCTION BY ELECTRON IMPACT IN MIXTURES OF ATOMIC AND MOLECULAR HYDROGEN

George M. Prok and Carl F. Monnin Washington 1967 18 p refs Presented at 9th Ann. Meeting of the Plasma Phys. Div. of the Am. Phys. Soc., Austin, Tex., 8–11 Nov. 1967
(NASA-TM-X-52344) CSCL 20H

Energy required for proton and molecular hydrogen ion production by electron impact was calculated for a tenuous hydrogen plasma. The cost was determined for various degrees of dissociation from 0 to 100 percent. The model assumed was a Maxwellian electron gas, in the temperature range of 3 to 100 eV, interacting with cold ground state neutrals. The concentration of the 2s metastable state of atomic hydrogen is shown to be negligible for the cost calculations. The cost decreases sharply with the degree of dissociation, and at energies between 40 and 100 eV and dissociation greater than 5 percent. The results for the monoenergetic case and Maxwellian case agreed to within about 6 percent. At 25 percent dissociation, the proton production cost is about a factor of three greater than that in atomic hydrogen. When the degree of dissociation is 40 percent, the proton production cost is only a factor of two greater than in atomic hydrogen, but it is nearly three orders of magnitude less than in molecular hydrogen. Author

N68-24661*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

INELASTIC SCATTERING FORM FACTORS USING PROJECTED HARTREE–FOCK WAVE FUNCTIONS

Richard C. Braley and William F. Ford Washington May 1968 28 p refs
(NASA-TN-D-4566) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The theory of inelastic scattering is formulated, using detailed nuclear wave functions which are obtained from nuclear structure calculations. The inelastic scattering is assumed to proceed through a direct reaction, and nuclear states are obtained by projecting states of good (J^2, J_z) from a variational Hartree–Fock wave function. General expressions for transition amplitudes and the nuclear form factors are derived, and the form factors for inelastic proton scattering are presented. These form factors are compared with those based on the shell model and macroscopic collective model. It is concluded that the restrictions imposed in the Hartree–Fock model must be relaxed if the model is to give the correct order of magnitude for reaction cross sections. Author

N68-24675# Illinois Univ., Urbana.
THE REACTIONS $K^-p \rightarrow \Sigma^+\pi^+$, $\Sigma^+\pi^+\pi^+\pi^-$, AND $\Sigma^+\pi^+K^+K^-$ AT 4.1 GeV/C AND 5.5 GeV/c
James Stavert Loos (Ph.D. Thesis) Feb. 1968 226 p refs
(Contract AT(11-1)-1195)
(COO-1195-116) CFSTI: HC $3.00/MF $0.65

The data presented and discussed were obtained from K^-p interactions at 2.1 GeV/c and 5.5 GeV/c in the MURA thirty-inch hydrogen bubble chamber. Meson (K^-) track lengths equivalent to 0.95 μb per event and 0.27 μb per event were analyzed at 4.1 GeV/c and 5.5 GeV/c, respectively. Differential cross sections are given for the $\Sigma^+\pi^+$ final states, and the results obtained agree well with extrapolated results from lower energies. The data for $\Sigma^+\Sigma^-$ is interpreted in terms of the Regge pole model. A search for the existence of hyperon resonances in the mass region above 1900 MeV/c^2 is made in the $\Sigma^+\pi^+\pi^+\pi^-$ data, but no evidence for such resonances is found. Consistent with results from lower energies, this reaction appears to be dominated by quasi-three-body processes in which either the $Y_0^*(1405)$, $Y_0^*(1520)$, or $\rho(770)$ is produced. Cross sections and production angular distributions for the various resonance productions are given. Production of $Y_0^*(1405)$, $Y_0^*(1520)$, and $\phi(1020)$ are observed in the $\Sigma^+\pi^+K^+K^-$ data. Cross sections and production angular distributions are given for the observed resonant processes. A measurement of the mass and width of the $\phi(1020)$ yields a mass of 1020.8 ± 1.0 MeV/c^2 and a width of $1.7\ ^{+1.6}_{-1.3}$ MeV/c^2. Author (NSA)

N68-24680# Illinois Univ., Urbana. Dept. of Physics.
SPIN-PARITY ANALYSIS OF THE B MESON
D. Mortara, Ascoli, H. B. Crawley, and A. Shapiro Jan. 1968 7 p refs Presented at the 3d Topical Conf. on Resonant Particles, Athens, Ohio, 23–25 Nov. 1967
(Contract AT(11-1)-1195)
(COO-1195-110; CONF-671122-4) CFSTI: HC $3.00/MF $0.65

A study of the $\omega^0\pi^-p$ final state produced by 5-GeV/c mesons (π^-) in a hydrogen bubble chamber is reported. The sample consists of 1571 events which fit the reaction $\pi^- + p \rightarrow \pi^- + p + \pi^+ + \pi^- + \pi^0$. The most prominent feature of this reaction is the production of the meson (B) which can be seen from the $\omega\pi$ mass spectrum. The spin and parity are calculated for the meson (B). NSA

N68-24703# Weizmann Inst. of Science, Rehovoth (Israel).
NUCLEAR PHYSICS
I. Talmi et al *In its* Sci. Activities 1967 [1968] p 189–208 refs (See N68-24697 14-23)

Abstracts are presented for a variety of studies ranging from theoretical physics to experimental efforts in high energy and low energy nuclear physics, and various types of instrumentation were also developed. Electromagnetic properties of medium and heavy nuclei were investigated, including lifetime measurements, Coulomb excitation, and quadrupole moments of excited states by Coulomb excitation. Both elastic and inelastic resonant scatterings were investigated and related to the low energy structure of analog nuclei. Detailed analyses were made of the fission process, the shape of fissioning nuclei, and the time sequence of relevant events. Elementary particle interactions at high energies were recorded in bubble chambers, proton–proton collisions and similar reactions were studied; and strong interaction dynamics investigations included bootstrap calculations, symmetry properties, hadronic currents, and electromagnetic properties of hadrons. M.W.R.

N68-24706 European Organization for Nuclear Research, Geneva (Switzerland). Data Handling Div.
THE CORRECTION FOR GEOMETRICAL LOSSES IN A BUBBLE CHAMBER
D. J. Holthuizen 22 Mar. 1968 31 p refs
(CERN-68-10)

The difficulties encountered in bubble chamber measurements of particle tracks which are in the direction of the magnetic field are enumerated, and ways of correcting for the loss of these tracks and weighing the remaining events are considered. An experiment with spherical symmetry for studying the existence of a loss of events having tracks of this kind is discussed, and a FORTRAN program method is described for calculating these weights for two prongs and four prongs. In all calculations the initial directions of the tracks at the production vertex were used, with no change in direction due to the magnetic field taken into account. The probability of being able to measure a track is considered to be a function of the initial parameters only. An exact calculation is performed and is checked by using Monte Carlo techniques. The program is extended to cylindrically symmetrical problems. It is pointed out that the need for correction is less than in the spherically symmetrical case because the secondary tracks tend to go in the direction of the axis of cylindrical symmetry which is generally perpendicular to the optical axis. M.G.J.

N68-24718# Brookhaven National Lab., Upton, N. Y.
THE THERMAL CROSS SECTIONS AND PARAMAGNETIC SCATTERING CROSS SECTIONS OF THE Yb ISOTOPES
S. F. Mughabghab and R. E. Chrien 1967 13 p refs Presented at the 2nd Conf. on Neutron Cross Sections and Technol., Washington, D. C.
(BNL-12263; CONF-680307-8) CFSTI: HC $3.00/MF $0.65

The total cross sections of oxide samples highly enriched in ^{170}Yb, ^{171}Yb, ^{172}Tb, ^{173}Yb, ^{174}Yb, and ^{176}Yb were measured at the BNL fast chopper at the BGRR, using 9.9- and 29.74-m flight paths. The total cross sections of the isotopes are found to be 17.0±1.0 b, 57±3 b, 10.2±1.5 b, 28±2 b, 142±5 b, 14.9±1.0 b, respectively. An average value of 5.2±0.9 b was obtained for the paramagnetic scattering cross section of Yb+++ at 0.0253 eV, from the measurement on ^{170}Yb, ^{172}Yb, and ^{176}Yb, contrasted with a value of 28.1±2.5 b for Er+++. When the isotopic total cross sections are compounded to form the total cross section of Yb, a value of 67.6±2.0 b is obtained. This is based in part on a thermal value of 3795±760 b for ^{168}Yb which is calculated from the resonance parameters. Finally, the absorption and the nuclear scattering cross sections of these isotopes at 0.0253 eV are discussed. Author (NSA)

N68-24734*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DOUBLY EXCITED STATES OF H^- OF HIGH PRINCIPAL QUANTUM NUMBER: IMPLICATIONS FOR ELECTRON-ATOM IONIZATION
A. Temkin, A. K. Bhatia, and E. Sullivan May 1968 38 p refs
(NASA-TM-X-63214; X-641-68-177) CFSTI: HC $3.00/MF $0.65
CSCL 20H

Insight into the threshold region of electron-atom ionization can be gained by examination of the nature of the doubly excited states of the compound ion. A study of these states for H^- has

been initiated with two types of variational wave functions. One, ψ_W, has the two electrons at roughly equal distances from the nucleus; the other, ψ_D, has one electron at a very much farther distance such that it sees the dipole potential caused by the inner electron and the nucleus. Both functions are constructed to be eigenfunctions of the operator Q_N which projects out all states of the target of principal quantum number less than N, and renders the energy subject to a minimum principal. If the number of states for which ψ_W yields a lower energy than ψ_D is proportional to N^{γ} than an extrapolation argument shows that the threshold yield curve will be effectively proportional to $E^{(3-\gamma)/2}$. Calculations have been done to N=5 for ψ_D and N=9 for ψ_W. Only the lowest of the ψ_W states is lower than the corresponding ψ_D state. The results suggest γ in the range $0 < \gamma \leq 1/2$. Some comments on Wannier's theory of ionization are made. Author

N68-24744# International Union of Crystallography. Commission on Crystallographic Apparatus.
METHODS OF OBTAINING MONOCHROMATIC X-RAYS AND NEUTRONS. BIBLIOGRAPHY 3
F. H. Herbstein, ed. 1967 84 p
(NP-17314)

The bibliography is divided into four parts under the following headings: general references, monochromation of X-rays by balanced filters, monochromation of X-rays by crystals, and monochromation of neutrons. The references in each part are organized on a chronological basis, and each part is accompanied by an author index. Short abstracts in English are given for most papers. NSA

N68-24746# Gt. Brit. National Inst. for Research in Nuclear Science, Chilton. Rutherford High Energy Lab.
NIMROD OPERATION AND DEVELOPMENT Quarterly Report, 1 Jul.–30 Sep. 1967
D. E. Gray, ed. Oct. 1967 27 p
(RHEL/R-155) HMSO: 4s

The NIMROD beam was on for High Energy Physics Research for 67.86% of H.E.P. scheduled operating time. One experiment was completed, three continued through and one commenced this quarter. A target mechanism which facilitates rapid changing of internal targets inside the NIMROD vacuum vessel is described. Radiation surveys associated with the extracted proton beam are discussed. Construction of the second extracted proton beam and associated subsidiary beams continues. Author (NSA)

N68-24765# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
ELASTIC pHe^4 BACKWARD SCATTERING AT 665 MeV PROTON ENERGY [UPRUGOE pHe^4 RASSEYANIE NAZAD PRI ENERGII PROTONOV 665 MeV]
V. I. Komarov and O. V. Savchenko 1968 14 p refs In RUSSIAN
(JINR-P1-3720)

The differential cross section of 665-MeV proton elastic scattering by ^{4}He nuclei at an angle of 169° (c.m.s) was measured by the scintillation counter method. The obtained value $(1.2 \pm 0.3)\ 10^{-31}$ cm^2 ster^{-1} at 9.5 f^{-1} momentum transfer is compared with the theoretical estimation based on the idea of nuclear matter density fluctuations. Author (NSA)

N68-24776# Wisconsin Univ., Madison.
FAST NEUTRON ENERGY MEASUREMENTS
J. C. Davis and F. T. Noda 1 Mar. 1968 7 p refs Presented at 2d Conf. on Neutron Cross Sect. and Technol., Washington, D. C.
(COO-7-0456; CONF-680307-5) CFSTI: HC $3.00/MF $0.65

Neutron energies at which sharp resonances have been reported vary by as much as 200 keV for neutron energies around 7 MeV according to measurements at different laboratories. To investigate these differences the analyzing magnet of the Wisconsin Tandem Accelerator was recalibrated with an accuracy better than 0.1%. Energy loss and straggling were studied for Ni foils used as entrance windows for gas targets. The energies of some of the sharp structure in neutron total cross sections reported previously were measured with ^{7}Li(p,n), T(p,n), and D(d,n) neutrons. Neutron energies reported in Phys. Rev., 123: 209(1961) should be increased from 1 keV at 3.4 MeV to 22 keV at 7 MeV and from 10 keV just above 7 MeV to 83 keV at 16 MeV. Energies reported in Phys. Rev., 158: 1167(1967) should be increased from 6 keV at 4.5 MeV to 15 keV at 6 MeV and from 24 keV just above 6 MeV to 88 keV at 14 MeV. Neutron energies are determined to about 0.1%. Author (NSA)

N68-24785# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
CHALK RIVER NUCLEAR LABORATORIES PROGRESS REPORT, 1 JANUARY–31 MARCH 1968
31 Mar. 1968 86 p refs
(AECL-3108; PR-P-77) Available from Atomic Energy of Canada, Ltd., Chalk River: $2.00

Research activities in various branches of physics are summarized, including solid state studies and solid state radiation detectors. Nuclear physics investigations were concerned with inelastic scattering, lifetime measurements of various isotopes, and fission induced by direct actions. Beta ray spectroscopy, radioisotope standardization, and counter development projects were reported by the general physics laboratory. Neutron physics studies were concerned with crystal dynamics, phase transitions, neutron scattering, and related subjects. Studies in theoretical physics dealt with electromagnetic fields, nuclear shell models, quadrupole magnet pole shapes, binding energy, vibrational truncation and relaxation, translational absorption, beam matching, and related topics. M.W.R.

N68-24794# California Univ., Berkeley. Lawrence Radiation Lab.
PION-PROTON ELASTIC SCATTERING: LOW ENERGY EXPERIMENTS AND PHASE SHIFT ANALYSES
Claiborne Johnson and Herbert Steiner Dec. 1967 41 p refs Presented at Conf. on Pion N Scattering, Irvine, Calif.
(Contract W-7405-ENG-48)
(UCRL-18001; CONF-671203-5) CFSTI: HC $3.00/MF $0.65

The status of π p elastic scattering experiments below p_π = 2 GeV/c is briefly reviewed. Then the phase shift analysis is discussed including the methods used, results obtained, and some of the problems encountered. NSA

N68-24804# Tokyo Univ. (Japan). Dept. of Physics.
ON THE ASYMPTOTIC BEHAVIOR OF ELECTROMAGNETIC FORM FACTORS
M. Yamada [1968] 25 p refs
CFSTI: HC $3.00/MF $0.65

Electromagnetic form factors for composite particles are discussed. It is shown that the form factor of π-meson behaves like $(\log t)^n/t^2$ (n=1 or 2) for large positive momentum squared t, if π-meson is assumed to be a bound state of nucleon and anti-nucleon system. This is verified without any approximation other than S-S equation with a general kernel, for spinless nucleon, and n=1 for this case. Some approximations are taken when we include the spin of nucleon, and n=2 for this case, but it is argued that this conclusion may be true in general. Some discussions are added on the large t behavior of the form factor of nucleon, when it is assumed to be a bound state. Author

N68-24811# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.

STUDY OF THE LOW-ENERGY GAMMA SPECTRA OF THE $Th^{231} \rightarrow Pa^{231}$ DECAY [ETUDE DU SPECTRE GAMMA DE BASSE ENERGIE DE LA DESINTEGRATION $Th^{231} \rightarrow Pa^{231}$]

Anne-Marie Pelletier (Ph.D. Thesis) 1966 34 p refs In FRENCH (NP-17285)

The low-energy γ spectra from the $^{231}Th \rightarrow {}^{231}Pa$ decay detected with a sodium iodide crystal were studied. The ratio of the intensity of the γ transitions at 25.6 and 84.1 keV was examined in detail. For the preparation of a concentrated solution of ^{231}Th, the ^{235}U and ^{231}Th were separated on anion resin, and the Th was entrained by Fe. The Fe-entrained Th was then fixed on cation resin and reextracted by oxalic acid. A technique for the measurement of the low-energy γ spectra was developed. The ratio of the intensities of the transitions at 22 and 88 keV of the ^{109}Cd spectra was evaluated as 24.0 ± 0.6. These data are in good agreement with that found by others and were used to test the reliability of the apparatus. A numerical method for analysis of a complex γ spectrum of ^{231}Th was studied. The analysis method has the inconvenience of being tedious. The ^{231}Th spectrum measured up to 120 keV shows a distribution of the rays. The energies of the rays are those of the peaks of the ^{231}Th spectra detected by a γGe(Li) junction. The dispersion of the results on the intensities of the rays is probably due to imprecision in the measurements caused by the derivative of the electronic devices. A spectra stabilizer is necessary for more precise measurements. The ratio of the intensities of the rays at 25.6 and 84 keV was evaluated to be 1.8 ± 0.2. Author (NSA)

N68-24812# Akademiya Nauk SSSR, Novosibirsk. Inst. Yadernoi Fiziki.

A CHECK OF QUANTUM ELECTRODYNAMICS IN ELECTRON–ELECTRON SCATTERING [PROVERKA KVANTOVOI ELEKTRODINAMIKI V RASSEYANII ELEKTRONOV NA ELEKTRONAKH]

G. I. Budker, E. A. Kushnirenko, R. L. Lebedev, A. A. Naumov, A. P. Onuchin et al 1967 14 p refs In RUSSIAN (NP-17322)

The angular distribution of electron–electron scattering was measured on the counter beam over the angle range 40 to 90° at energy values of 2×43, 2×135 and 2×160 MeV using a system of spark chambers with photographic recording. The results confirm the validity of quantum electrodynamics laws down to distances of 0.5 fermi with 95% confidence. NSA

N68-24814# Aeronautical Research Council (Gt. Brit.).

A SURVEY OF THE INFRARED RADIATION PROPERTIES OF CARBON DIOXIDE

J. P. Hodgson (Manchester Univ.) London HMSO 1968 86 p refs Supersedes ARC-28645, X67-17955 (ARC-CP-981; ARC-28645) HMSO: 15s 6d

This paper consists of a survey of theoretical and experimental approaches to the prediction of the low resolution emissivity of an infrared band of a polyatomic molecule. Spectral band models and molecular models are discussed, with carbon dioxide being taken as an example of such a molecule. Author (ESRO)

N68-24822 Maryland Univ., College Park.

SANDWICH SAMPLE TECHNIQUE FOR DETERMINING SECONDARY X-RAY LINE INTENSITIES IN ELECTRON PROBE MICROANALYSIS

James Douglas Brown (Ph.D. Thesis) 1966 177 p Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-2364

Fluorescence resulting from the absorption of characteristic lines is one of three major corrections in quantitative electron probe microanalysis. The methods proposed for the fluorescence corrections are critically reviewed. The two principal approximations which limit the accuracy of these corrections are the expressions used to approximate the relationship of absolute intensities of characteristic lines of different elements and the distribution as a function of depth for the primary radiation. A method for measuring the distribution of secondary radiation as a function of depth in the sample is developed using a sandwich sample technique. The primary distribution was measured for four electron energies using a zinc tracer in copper. An equation is developed for calculating the distribution of secondary radiation as a function of depth in the sample from a known primary distribution. Distributions can be calculated for any sample composition and for any experimental geometry. A listing of a computer program written in FORTRAN is given to facilitate the calculations. Dissert. Abstr.

N68-24827# Paris Univ. (France).

COLLECTIVE MOTIONS OF THE RELATIVISTIC GRAVITATIONAL GAS

Ph. Droz-Vincent and Remi Hakim Dec. 1967 26 p refs (LPTHE-TH-237)

The relativistic gravitational gas is studied with the help of the linearized Einstein equations to the one-particle Liouville equation. As a consequence, a kinetic equation is derived for the collective motions of a small perturbation of the gas. This equation is a linear integro-differential equation of the same kind as the Vlasov equation. Author (NSA)

N68-24828# Mound Lab., Miamisburg, Ohio.

SHAPE FACTORS AFFECTING THERMAL DIFFUSION IN THE EXP-6 BUCKINGHAM MODEL

J. M. Saviron, D. Gonzalez, and J. A. Madariaga [1966] 6 p refs Transl. into ENGLISH from Anales de Fis. y Quim. (Madrid), Ser. A, v. 61, 1966 p 361–362 (Contract AT(33-1)-GEN-53) (MLM-1467(TR)) CFSTI: HC $3.00/MF $0.65

The effects of shape factors, which define the molecular interaction of the gas, on thermal diffusion in Clusius–Dickel columns are considered. The shape factors for the Exp-6 Buckingham potential were calculated and tabulated. NSA

N68-24834# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

TABLE OF CHANGED PARTICLE ENERGIES VERSUS MAGNETIC FIELD STRENGTH × ORBIT RADIUS FOR p,d,t, He 3, α PARTICLES FROM 10^5 TO 1.2×10^6 G CM [TABLE DES ENERGIES DES PARTICULES CHARGEES EN FONCTION DE LA RIGIDITE MAGNETIQUE POUR p,d,t, HE 3 DE 10^5 A 1.2×10^6 G CM]

Louis Bianchi Dec. 1967 44 p refs In FRENCH (CEA-R-3383)

A table of charged particle energies versus magnetic field strength × orbit radius (Bρ) is presented. Particles included are p,d,t, $^3He^{++}$, $^4He^{++}$. Values of Bρ range from 1×10^5 to 1.2×10^6 G cm by steps of 500 G cm. Author (NSA)

N68-24837# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

MEASUREMENT OF THE SCATTERING CROSS SECTION OF NONFISSILE NUCLEI BY THE TIME-OF-FLIGHT METHOD. DETERMINATION OF THE SPIN OF SOME EXCITED STATES [MESURE DE LA SECTION EFFICACE DE DIFFUSION DE NOYAUX NON FISSILES PAR LA METHODE DU TEMPS-DE-VOL. DETERMINATION DU SPIN DE QUELQUES ETATS EXCITES]

Jean Trochon Oct. 1967 83 p In FRENCH (CEA-R-3360)

The Saclay 45-MeV Linear Accelerator is used as a pulsed neutron source to carry out experiments in the resonance energy region. Sometimes, when the right conditions are available, the transmission can give all the resonance parameters such as E_r, Γ_π $2g\Gamma_n$ and $J = l \pm 1/2$, where l is the spin of the target nucleus. Usually, however, complementary data from scattering measurements are required to obtain the value of spin J. Such experiments have been performed; results obtained on ^{103}Rh and ^{197}Au in the energy range from 40 to 700 eV are presented. Author (NSA)

N68-24840# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

MEASUREMENT OF A THERMAL NEUTRON FLUX USING AIR ACTIVATION [MESURE DE FLUX DE NEUTRONS THERMIQUES PAR ACTIVATION D'AIR]

Michel Guyonvarh, Pierre Lecomte, and Roger Le Meur Dec. 1967 44 p refs In FRENCH

(CEA-R-3338)

It is necessary to know, in irradiation loops, the thermal neutron flux after the irradiation device has been introduced and without being obliged to wait for the discharge of this device. In order to measure the flux and to control it continuously, one possible method is to place in the flux a coiled steel tube through which air passes. By measuring the activity of ^{41}Ar, and with a knowledge of the flow rate and the temperature of the air, it is possible to calculate the flux. An air-circulation flux controller is described and the relationship between the flux and the count rate is established. The accuracy of an absolute measurement is about 14%; that of a relative measurement is about 3%. The measurement can be carried out equally well whether the reactor is operating at maximum or at low power. The measurement range goes from 10^9 to 10^{15} n cm^{-2} sec^{-1}, and it would be possible after a few modifications to measure fluxes between 10^5 and 10^{15} cm^{-2} sec^{-1}. Finally, the method is very safe to operate: there is little risk of irradiation because of the low specific activity of the ^{41}Ar formed, and no risk of contamination because the decay product of ^{41}Ar is stable. This method, which is now being used in loops, is thus very practical. Author (NSA)

N68-24848 Georgetown Univ., Washington, D. C.

AN ITERATIVE TECHNIQUE FOR DETERMINING THE FIRST-ORDER DENSITY MATRIX

Anthony John Galli (Ph.D. Thesis) 1967 148 p

Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-2921

An iterative method is developed to calculate directly the first-order density matrix of single-configuration representable molecules. The general approach is to use the constrained iterative matrix equation $P_{n+1} = 3P^2-2P^3 + \Sigma_{(i)} \lambda^{(n)}\sigma_i$ starting from some initial guess P_0; this iterative equation yields an idempotent matrix (the first-order density matrix is idempotent) that satisfies the conditions 2 tr P $\sigma_i = \langle\hat{\sigma}_i\rangle$, where the $\hat{\sigma}_i$ are one-body operators. In the present paper the $\hat{\sigma}_i$ are chosen to be observables with experimentally known expectation values $\langle\hat{\sigma}_i\rangle$ (a semi-empirical approach), but the method is applicable to the more general case where the $\langle\hat{\sigma}_i\rangle$ are purely theoretical quantities. This paper investigates the constrained iterative equations with regard to their mathematical, physical, and practical aspects. It is shown, as a result of this investigation, that the idempotent matrix solutions to these equations exist, and represent reasonable approximations to the first-order density matrix. Dissert. Abstr.

N68-24891 California Inst. of Tech., Pasadena.

AN ISOBAR MODEL OF NUCLEON COMPTON SCATTERING

Robert William Weinman (Ph.D. Thesis) 1967 81 p

Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-436

The Compton scattering of photons by nucleons is described in terms of an isobar model for the resonant states, using a spin 3/2 propagator and couplings at the vertices obtained from a phenomenological analysis of pion photo-production. The full Born term is taken into account, as well as contributions from pi and eta exchange in the t-channel. Numerical results are obtained at 90° in the center of mass system for the energy range 300 to 800 MeV which agree substantially with experiment. The recoil nucleon polarization and the cross-sections for polarized photons are also calculated over this energy range. Dissert. Abstr.

N68-24892# Los Alamos Scientific Lab., N. Mex.

REAL PART OF THE FORWARD SCATTERING AMPLITUDE

Leona Stewart [1967] 18 p refs Presented at the 2nd Conf. on Neutron Cross Sect. and Technol., Washington

(Contract W-7405-ENG-36)

(LA-DC-9179; CONF-680307-25) CFSTI: HC $3.00/MF $0.65

Wick's derivation of the lowest limit for the zero-degree cross section in the elastic scattering of neutrons is now frequently employed as a good approximation to the cross section itself. Derived from the optical theorem, Wick's limit is simply the imaginary part of the amplitude squared. Through the direct relationship to the total cross section it becomes an important tool in evaluation and interpretation. Using the "strong absorption" assumption in all partial waves, the real part of the amplitude reduces to zero, but this assumption also predicts polarizations which are identically zero. Since large neutron polarizations have been observed for many elements in the MeV region, the conditions under which the real part of the forward scattering amplitude approaches zero are studied in more detail. Complex phase-shift expansions show important relationships between the total, elastic, and reaction cross sections and the elastic angular distributions. Certain conditions under which Wick's limit becomes a poor approximation to the zero-degree cross section are examined. The real and imaginary parts of the amplitude and the total and partial cross sections have been calculated for the $d_{5/2}$ state of A = 56 using the optical model with real and complex potentials. Author (NSA)

N68-24893# Lyon Univ. (France).

CONTRIBUTION TO THE STUDY OF THE REACTIONS (α, xn) ON HOLMIUM AND THULIUM AT LOW AND MEDIUM ENERGIES. APPLICATION TO THE PREPARATION OF NEUTRON-DEFICIENT ISOTOPES OF THULIUM AND LUTETIUM [CONTRIBUTION A L'ETUDE DES REACTIONS (α, xn) SUR L'HOLMIUM ET LE THULIUM A BASSE ET MOYENNE ENERGIE. APPLICATION A LA PREPARATION D'ISOTOPES DEFICIENTS EN NEUTRONS DU THULIUM ET DU LUTECIUM]

Albert Demeyer (Ph.D. Thesis) Nov. 1967 112 p refs In FRENCH

(LYCEN-6781)

The preparation and identification of the reaction products obtained by bombardment of ^{165}Ho and ^{169}Tm with α particles were studied. The determination of the absolute cross sections made it possible to choose the energy value where the probability for the formation of a given isotope is a maximum. The estimation of the ratio of the absolute cross sections of the isomers, for a high excitation energy of the nucleus, is generally sufficient to identify the isomer spin state of the ground state. The (α,xn) excitation functions furnish a test for the region of validity of the statistical theory. It was proposed to interpret the behavior of these functions at high energies within the framework of quantum mechanics using the Born approximation. The establishment of these excitation functions made it possible to discuss the parameters and quality of the α particle beam of the synchrocyclotron at Lyon. The experimental results made it possible to prepare sources designed for the β- and γ-spectrometric study of their nuclear schemes. Various techniques for rapid separation and deposition in thin foils were developed. NSA

N68-24899# United Kingdom Atomic Energy Authority, Harwell (England).
ESTIMATING LONG-RANGE INTERACTIONS BY A MODIFIED METHOD OF STRONG COUPLING
R. Damburg and E. Karule Apr. 1967 13 p refs Transl. into ENGLISH from Russian
(NP-TR-1613) CFSTI: HC $3.00/MF $0.65

A modified method of strong coupling is presented which makes it possible to make full allowance for dipole and quadrupole polarization by solving a limited number of integral–differential equations. The extremal properties of the phase are retained. NSA

N68-24906 Kansas State Univ., Manhattan.
STUDIES OF CORE-PARTICLE MODELS OF THE NUCLEUS
Philip Martin Rinard (Ph.D. Thesis) 1966 105 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-698

A model of nuclei consisting of an excited core with one extra particle is developed in terms of parameters resulting from the use of an interaction of a general nature between the core and particle. Consequences of the expressions for energy levels, static moments and transition rates are discussed separately and then the whole model is fitted onto three nuclei. The results of this fit for Au^{197} indicate that this nucleus may be thought of as a core-plus-one-particle nucleus although it has three protons outside closed shells. Measured quantities that are well determined are well accounted for whereas the more obscure values of the transition rates are more difficult to draw conclusions from. These results are compared to those obtained by other investigations. An extension of this model is sought by considering two particles outside a core. One expression of the interactions among these three bodies is found to have a special case already studied elsewhere but this form of the interaction is not readily generalized to more than two particles. Dissert. Abstr.

N68-24909# Du Pont de Nemours (E.I.) and Co., Aiken, S. C. Savannah River Lab.
FOIL MEASUREMENTS OF INTEGRAL CROSS SECTIONS OF HIGHER MASS ACTINIDES
R. L. Folger, J. A. Smith, L. C. Brown, R. F. Overman, and H. P. Holcomb 1 Mar. 1968 7 p refs Presented at 2d Conf. on Neutron Cross Sect. and Technol., Washington, D. C., 4–7 Mar. 1968
(Contract AT(07-2)-1)
(DP-MS-67-112; CONF-680307-6) CFSTI: HC $3.00/MF $0.65

Thermal and resonance integral capture cross sections were deduced for ^{242}Pu, ^{243}Am, ^{244}Cm, ^{245}Cm, ^{246}Cm, ^{249}Bk, ^{250}Cf, ^{252}Cf, and ^{253}Es from measurements of activation products in unshielded and cadmium-covered thin targets which were irradiated in high-flux charges at Savannah River. Analytical uncertainties in chemical yields were minimized by extensive use of mass spectrometry and alpha pulse energy analysis to determine isotope ratios. The nvt exposures were monitored by the $^{59}Co(n,\gamma)^{60}Co$ reaction. The capture cross sections for ^{242}Pu, ^{248}Cm, ^{249}Bk, and ^{252}Cf were used to complete the set of self-consistent cross sections for the chain ^{242}Pu through ^{252}Cf. Author (NSA)

N68-24926 Maryland Univ., College Park.
ON THE NECESSITY OF PRODUCTION AMPLITUDES IN QUANTUM FIELD THEORY
Franklin Fan-Keung Cheung (Ph.D. Thesis) 1966 173 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-2378

Previously, it was proved by S. Aks that production amplitudes are necessary in scattering of two neutral scalar particles with pairing symmetry. We generalize the proof to scattering of two particles with arbitrary spins and isotopic spins. The generalization is done by steps. We start with specific cases like pion–pion scattering, neutral scalar particle without pairing symmetry and the pion–nucleon scattering, and work gradually towards the general case of arbitrary spins and isotopic spins. The result shows that quite generally, consistency between crossing symmetry and unitarity condition requires the existence of production processes in two particle scattering. We take as a working model that the scattering amplitudes satisfy the analyticity requirements of Mandelstam representation with a finite number of subtractions; but later show how our result follows directly from unitarity condition, crossing relation and analyticity that can be established from the axioms of quantum field theory. Dissert. Abstr.

N68-24932 Florida Univ., Gainesville.
LOWER BOUNDS TO EIGENVALUES OF THE SCHROEDINGER EQUATION
Timothy Michael Wilson (Ph.D. Thesis) 1966 62 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-3518

It has been shown that the bracketing theorem arising from the partitioning technique for solving the Schrodinger equation may be used to determine upper and lower bounds to energy eigenvalues. A new method, based on the partitioning technique, is developed that permits the calculation of lower bounds to the ground state and excited states of a Hamiltonian $H=H_0+V$ which is bounded below, where V is a positive definite parturbation. The method is applied to the calculation of lower bounds to the 2^3S and 3^3S states of He and to the 2^3S, 3^3S and 4^3S states of Li^+. Dissert. Abstr.

N68-24946 Utah Univ., Salt Lake City.
MUON PAIR PRODUCTION BY MUONS
Marvin Leon Morris (Ph.D. Thesis) 1967 61 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-3230

A prototype of the University of Utah neutrino detector was successfully operated on the University of Utah campus from March to August, 1966. The prototype demonstrated the feasibility of two types of detectors, cylindrical spark counters and large area directional Cerenkov detectors, along with their associated automatic data handling system. The prototype was used to observe muon pair production by cosmic ray muons. In a total running time of 837 hours, 33 events which are believed to be examples of symmetric muon pairs produced in the energy range 1 to 2 Gev were observed. During this time 2,060,000 cosmic ray muons traversed the prototype. The background from all sources is shown to be negligible. The observed cross section is shown to agree qualitatively with theory. Uncertainties in the detection efficiency of the prototype for small angle events prevented a more accurate comparison with theory. Dissert. Abstr.

N68-24949 Cincinnati Univ., Ohio.
THE (P,2P) REACTION IN HELIUM AND CARBON
George Donald Kramer (Ph.D. Thesis) 1966 54 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-1970

The (p,2p) reaction in helium and carbon was experimentally investigated by Stubbins whose results show a broader angular distribution between the two outgoing protons from carbon than from helium. This analysis was undertaken in an attempt to explain the broadening. Following the collision of the incident proton with a proton in the nucleus, the two outgoing protons traveled through more nuclear matter, on the average, before leaving the carbon nucleus than they do in passing out of the helium nucleus. The assumptions are that the interaction occurred with equal probability throughout the entire volume of the nucleus, and that the target protons had the same momentum distribution in both nuclei. To compare with the experiment, the direct interaction calculation was made using relativistic kinematics, since the incidents proton

energy was 770 MeV. The angular distributions were found to be in close agreement with the experiment. There remained a slight difference in the position of the theoretical peak of the angular distribution for helium compared to the experiment which comes into agreement when an excitation energy is subtracted from the energy available to the two outgoing protons. Dissert. Abstr.

N68-25008# Stanford Univ., Calif. Linear Accelerator Center.
PHOTOPRODUCTION OF ρ^0 MESONS IN A HYDROGEN BUBBLE CHAMBER AT PHOTON ENERGY LEVELS UP TO 5.8 GEV [PHOTOPRODUKTION VON NELLTRALEN RHO MESONEN IN EINER WASSERSTOFFBLASENKAMMER BEI PHOTONENERGIEN BIS ZU 5.8 GEV]
H. Spitzer Nov. 1967 125 p refs Transl. into ENGLISH from the Rept. DESY-F-1/4
(SLAC-TRANS-79; DESY-F-1/4) CFSTI: HC $3.00/MF $0.65

About 8400 reactions of the type $\gamma p \rightarrow p\pi^+\pi^-$ were analyzed in 640,000 pictures; ρ^0-production is the dominant process in this reaction above 1.1 BeV. Results on the total cross sections, differential cross sections and decay matrix elements are given for various photon energy intervals. The total cross section rises above threshold to 20 μb and falls slowly to about 16 μb at 5 BeV. The magnitude and the energy dependence of the total cross section are successfully explained by a combined vector-dominance and quark model. Both the cross sections and the decay distributions indicate a mainly diffractive production mechanism. At high energies the ρ peak is distorted and shifted to low mass values. Several effects of the interference, e.g., a strong variation of the diffraction slope with the invariant $\pi^+\pi^-$ mass near the resonance and a dependence of the ρ mass distribution on the production angle are found. Author (NSA)

N68-25013 Michigan State Univ., East Lansing.
PHASE SPACE DENSITY STUDIES ON CYCLOTRON ION SOURCES
Merrit Lee Mallory (Ph.D. Thesis) 1966 88 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-1655

A facility has been set up for development and testing of cyclotron ion sources with special emphasis on capability for rapid phase space density measurements. H^+ ions from the test source are accelerated into a −30 kV dc "dee" and magnetically deflected through 180°. A system of remotely adjustable slits is mounted inside the dee and is used to determine the axial and radial emittance areas. The phase space density has been determined from the axial and radial emittance area measurements at a variety of arc conditions and for a number of source geometries. All studies have employed a 0.062" × 0.375" source output slit with arc currents varied from 1 to 5 amps. Geometrical variations have been principally concerned with source face shapes. Both axial and radial emittance areas from a normal flat source are found to have a considerable admixture of coherent motion which results in inefficient use of the aperture and also, in combination with nonlinear fields, can lead to an effective dilution of the phase space density. Dissert. Abstr.

N68-25014 Washington Univ., Seattle.
MOLECULAR LEVEL CALCULATIONS USING THE HARMONIC OSCILLATOR REPRESENTATION AND ANALYTICAL PROCEDURES
Ira Lawrence Karp (Ph.D. Thesis) 1966 151 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-2171

The objectives of this work are the following: (1) to formulate simple molecular physics problems using nuclear methods to estimate convergence rates, (2) to review and calibrate these nuclear methods in the case of H_2^+ and the ground state of the helium atom and the beryllium atom, and (3) to use the scheme to calculate the energy in the case of collinear H_3^{++}, in its ground σ_g state. To carry out this program, a W–B perturbation series, using an oscillator representation for the N-electron problem with two separate fixed nuclear centers is formulated through third order. The nuclear Coulomb potential is expanded in a multipole series and the entire theory comes out as a power series in the internuclear distance. The interelectronic potential matrix element is given over a wide range of parameters in terms of an explicit formula, an advance over previous work which is intractible for a wide range of parameters. Dissert. Abstr.

N68-25018 Pennsylvania Univ., Philadelphia.
STUDIES ON MOLECULAR ORBITAL THEORY AND ON THE INTERMOLECULAR POTENTIAL FOR ARGON
Robert Armando Sallavanti (Ph.D. Thesis) 1966 137 p refs
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-3104

Consideration is given to two approaches toward an open-shell self-consistent field molecular orbital (SCF-MO) theory. The first approach groups the electrons into a closed-shell group, an α-open-shell group, and a β-open-shell group. Constraining the molecular orbitals to be orthonormal, we minimize the total π-electronic energy using the variational principle. The second approach groups the electrons as in the first approach and has the same orthonormality constraints. However, here the total energy less the α-open-shell-β-open-shell exchange terms is minimized. The well-developed Pariser–Parr–Pople formalism is used to study the π-electronic structure of furan, benzofuran, dibenzofuran, oxazole, benzoxazole, and anthranil. Experimental data for the second virial coefficient of argon along with various numerical techniques is used to calculate potential well width as a function of depth for given values of the parameter representing the absolute depth of the well. Dissert. Abstr.

N68-25021 Brigham Young Univ., Provo, Utah.
ANGULAR DISTRIBUTIONS FOR ELASTIC AND INELASTIC E-HG SCATTERED AT LOW ENERGIES
Clayne Monson Yeates (Ph.D. Thesis) 1967 88 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-2586

Angular distributions from 40° to 120° of the ratio of elastic to inelastic e–Hg scattering are measured for incident electron energies of 30, 15, 7, and 5 e.v. The previous lower limit was 23 e.v. and no resolution of the $6\,^1P_1$ and $6\,^3P_0$ excitation cross sections had been achieved, hence the previous inelastic cross sections included all electrons with energy losses up to 7 volts. Resolution of these two levels is achieved, and the ratio of elastic to $6\,^3P_0$ excitation is plotted as a function of electron energy and scattering angle. A theoretical solution is given for the problem of tandem optical pumping, to obtain the fraction of Hg I atoms in the triplet P metastable states. This fraction is determined as a function of the intensity of illumination, and of the leakage from the metastable states. An attempt was made to scatter electrons from the metastable atoms to determine the efficiency of optical pumping, and to measure the angular distribution of the superelastic cross section. Dissert. Abstr.

N68-25037 Iowa State Univ. of Science and Technology, Ames.
A SPIN-ONE PARTICLE IN AN EXTERNAL ELECTROMAGNETIC FIELD
Dennis John Shay (Ph.D. Thesis) 1966 51 p
(Contract W-7405-ENG-82)
(IS-T-95) Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-2092

A single, manifestly covariant wave equation which describes a spin-one particle with anomalous magnetic dipole and anomalous electric quadrupole moments moving in an external electromagnetic field is given. In the free particle limit this equation reduces to the covariant Weinberg equations. This particle has mass m, charge e,

intrinsic magnetic dipole moment -en/4mc, and intrinsic electric quadrupole moment $en^2/8m^2c^2$. These two moments correspond to a g factor of 1/2 and a Q factor of -1/2. The wavefunction forms a basis for the (1,0) + (0,1) irreducible representation of the Lorentz group. The wave equation has the correct transformation properties under Lorentz transformations, space and time inversion, and charge conjugation. Dissert. Abstr.

N68-25040 Ohio Univ., Athens.
ELASTIC SCATTERING OF 14.1 MEV NEUTRONS FROM NITROGEN, OXYGEN, AND ARGON
Paul L. Beach (Ph.D. Thesis) 1966 80 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-1214

The differential elastic scattering cross sections of 14.1 MeV neutrons are measured for the target nuclei nitrogen, oxygen, and argon. The elastic scattering is separated from the inelastic contributions to the spectra for all three samples. From the differential cross sections the total elastic cross sections are found. Optical model analysis gives the set of parameters for each sample which provides the best fit to the experimental data. The absolute normalization of each differential cross section was found by comparing the measured response of the spectrometer for scattering from protons and carbon to the known cross sections for these nuclei. The differential elastic cross sections for 14.1 MeV neutrons for nitrogen, oxygen, and argon are given with overall standard errors of 6–7 per cent. For nitrogen and oxygen, the results are compared with previous measurements. The elastic scattering of 14.1 MeV neutrons from argon has not been previously reported. Dissert. Abstr.

N68-25047# Oak Ridge National Lab., Tenn.
TOTAL NEUTRON CROSS SECTIONS OF ^{9}BE, ^{14}N, AND ^{16}O
C. H. Johnson, F. X. Haas, J. L. Fowler, F. D. Martin, R. L. Kernell et al 7 Mar. 1968 8 p refs Presented at 2d Conf. on Neutron Cross Sect. and Technol., Washington, D. C., 4–7 Mar. 1968
(CONF-680307-15) CFSTI: HC $3.00/MF $0.65

Total neutron cross sections of some light nuclei, measured with sufficient energy resolution to resolve most of the resonances at energies between ≈1.5 and 5.0 M are presented. These include the total cross section of ^{9}Be from 1.9 to 4.6 MeV with ≈25-keV resolution, the total cross section of ^{14}N from 2.0 to 4.2 MeV with ≈5-keV resolution, and the total cross section of ^{16}O from 1.80 to 3.65 MeV with ≈2-keV resolution. Author (NSA)

N68-25050# Brookhaven National Lab., Upton, N. Y.
ESTIMATED FISSION PROPERTIES OF TRANSRADIUM ISOTOPES
A. Prince [1968] 88 p refs Presented at 2d Conf. on Neutron Cross Sect. and Technol., Washington, D. C., 4–7 Mar. 1968
(CONF-680307-18) CFSTI: HC $3.00/MF $0.65

A systematic procedure for estimating thermal neutron fission and capture neutron cross sections and the fission and capture resonance integrals for transradium isotopes is outlined. The method involves establishing a correlation between the difference of the binding energy and fission threshold ($B_n - E_f$) and the cross sections and resonance integrals. Estimated values for σ_f, σ_γ, I_f, I_γ, the average number of prompt neutrons $\langle \nu_p \rangle$, α, η, and the average kinetic energy of fission fragments $\langle E_k \rangle$ are given. The method of analysis and recommendations for further study and possible improvements are presented. Author (NSA)

N68-25051# Brookhaven National Lab., Upton, N. Y.
GAMMA RAYS FOLLOWING NEUTRON CAPTURE IN IRON, SODIUM, AND THORIUM
O. A. Wasson, J. B. Garg (New York State Univ., Albany), R. E. Chrien, and M. R. Bhat 4 Mar. 1968 17 p refs Presented at 2d Conf. on Neutron Cross Sect. and Technol., Washington, D. C.
(BNL-12268; CONF-680307-12) CFSTI: HC $3.00/MF $0.65

The intensities of prominent γ rays from neutron capture in iron, sodium, and thorium were measured as a function of incident neutron energy at the HFBR fast chopper facility at Brookhaven. The partial capture cross section of 27 γ rays in iron was measured from thermal to 5-keV neutron energies. Additional γ rays were observed in the 1187-eV resonance and at thermal energy. In sodium, the observation of a ground-state γ ray in the thermal spectrum (E_γ=6960 ± 2.0 keV) with an intensity of ≈0.1 photons/100 captures supports the 2+ assignment of the 2.85-keV resonance. The γ-ray spectra from capture at thermal and in the four lowest energy S-wave resonances in ^{232}Th exhibit large fluctuations in the partial radiation widths. Author (NSA)

N68-25067 Ohio Univ., Athens.
SINGLE PION PRODUCTION IN π^-–p INTERACTIONS AT 1.114 GEV/C
William J. Beam (Ph.D. Thesis) 1966 64 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-1215

Interactions of the type $\pi^- + p \rightarrow \pi^- + p + \pi^0$ and $\pi^- + p \rightarrow \pi^+ + \pi^- + n$ at an incident pion momentum of 1.114 GeV/c are considered. The data are compared with the isobar model and with predictions of the Stodolsky–Sakurai ρ-exchange model. The liquid hydrogen bubble chamber is exposed to a separated π^- beam from the 3 GeV cosmotron. Approximately 4,000 two-pronged events are found in over 8,000 photographs in the chamber. The events are measured on digitized tool makers' stages. Effective mass distributions of outgoing particle pairs are determined. These distributions indicate that the interactions proceed through an intermediate stage consisting of an N^* (1238) isobar and a single pion in at least 50% of the cases. For events of the type $\pi^- + p \rightarrow N^{*++} + \pi^0 \rightarrow \pi^- + p + \pi^0$, the angle formed by the momentum vector of the N^{*++} decay pion and the normal to the production plane is computed in the N^{*++} rest system. Dissert. Abstr.

N68-25062# Miami Univ., Coral Gables, Fla. Center for Theoretical Studies.
CHARGE QUANTIZATION AND NON-INTEGRABLE LIE ALGEBRAS
C. A. Hurst Feb. 1968 50 p refs
(Grant AF-AFOSR-1266-67)
(CTS-T-PHYS-68-1; AD-667585)

The Schrodinger equation for the motion of an electric charge in the field of a magnetic monopole is examined to see how the quantization of the interaction constant follows from the requirement of rotational invariance. It is shown that the Hamiltonian can be extended to a self-adjoint operator, but the spectrum is split unless the usual quantization conditions are satisfied. The invariance domain of the generators of rotations in the Hilbert space of state vectors is also not large enough for the Hamiltonian to be essentially self-adjoint nor can the generators be integrated to give a representation of the rotation group unless the interaction constant is quantized. The problem is interpreted as the motion of a free particle on the group manifold of the rotation group and it is shown how the Schrodinger equation above is obtained if only a subspace of state vectors for this second problem is taken. This formulation is generalized to define a class of Hamiltonians which possess a symmetry group and a quantized interaction constant. The extension from the rotation group to the Poincare group is made and it is shown that the theory is Lorentz invariant but not local unless the quantized electromagnetic field is introduced. Author (TAB)

N68-25063# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.

BARYON RESONANCES AND SU_3 MIXING

Francis Halzen (Louvain Univ. —Belgium) and Michiji Konuma Mar. 1968 29 p refs

(RIFP-69) CFSTI: HC $3.00/MF $0.65

The increase of the number of baryon resonances reveals a new feature that there are several resonances which have common isospin, hypercharge, spin and parity. This situation forces us to treat reducible representation of SU_3 for the classification of the baryon resonances. In the reducible representation which has to do with these resonances there appear two or more tensor components which are connected with the same isospin and hypercharge. In such a case the physical baryon fields are in general expressed as linear combinations of these tensor components. In this article we treat the baryon with spin $S = 1/2$ and parity $P = +$. In addition to the usual octet, a pion–nucleon resonance or the so called Roper resonance is experimentally observed. Taking into consideration this resonance, we are obliged to use $8+8$ or $8+10^*$ or $8+27$ to describe the baryon with $S^P = 1/2^+$. The mass formula and the transition between the $3/2^+$ baryon and the $1/2^+$ baryon with an emission of a pion are discussed by adopting the effect of the mixing. The possibility $8+10^*$ is excluded through an analysis of the decuplet decay. Author

N68-25064# Japan Atomic Energy Research Inst., Tokyo. Thermalization Group.

BIBLIOGRAPHY FOR THERMAL NEUTRON SCATTERING

Mar. 1968 43 p

(JAERI-4043) CFSTI: HC $3.00/MF $0.65

The thermalization group of the Japanese Nuclear Data Committee has collected literature on measurements and calculations of thermal neutron scattering cross sections and basic studies of lattice dynamics, liquid and molecular dynamics. These references are needed for the data evaluation which is one of the main activities of the committee. This report is a list of the references classified by kinds of material, which are collected by group members. Author

N68-25067 Maryland Univ., College Park.

BARYON–BARYON REACTIONS AND SU3 SYMMETRY

Patrick David de Souza (Ph.D. Thesis) 1966 90 p

Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-2384

SU3 symmetry has been used in order to obtain relations between the cross sections for baryon–baryon reactions in the $_1S^0$ and $_3S^1$ states. The modifications of these relations for higher angular momentum states are derived and it is shown that the possible existence of strong coupling of the $_3D^1$ state to the $_3S^1$ state does not invalidate the above derived relations. In order to investigate the effect of mass splitting on these results a potential model calculation is carried out in order to verify the predicted equality of $_1S^0$ n–p and Σ^+–p cross-sections. The calculation indicates that this relationship is indeed satisfied and that further the Σ^- – n system has a possible gound singlet state with a binding energy $\leq$ 1 MeV. The multichannel Σ^-–p reactions are investigated with an SU3 invariant K-matrix using the Λ–p parameters of Burnstein and Alexander. A calculation of Σ^-–p cross sections is carried out for center of mass energies < 10 MeV. The results of this calculation are not in agreement with experiment. Dissert. Abstr.

N68-25070# Lyon Univ. (France).

STUDY OF THE G-FACTOR OF THE FIRST EXCITED STATE OF PT 196 [ETUDE DU FACTEUR G DU PREMIER ETAT EXCITE DU PT 196]

Michele Levy (Ph.D. Thesis) Dec. 1967 64 p refs In FRENCH

(LYCEN-6785)

The g-factor of the first excited state of ^{196}Pt was measured by the integral method of perturbed angular correlations. Two types of sources were used: a classical Fe–Au alloy, and a source where the ^{196}Au ions are injected in an ion target using an isotopic separator provided with post acceleration. Thus it is possible to compare the magnetic fields that predominate in the two types of sources and perhaps draw conclusions on the respective positions of the Pt nucleus in the crystalline lattice of Fe. Before the description of the experimental studies, a study is given of the even isotopes of Pt using the rotational–vibrational model. A perfect agreement was found between the experimental value and the theoretical values predicted for the calculations of Kumar and Baranger based on the rotational–vibrational model. It was deduced that the nuclei ^{192}Pt, ^{194}Pt, and ^{196}Pt are nuclei which vibrate around a position more or less deformed according to the isotope considered. The measurements made justify the supposition of Kalish, et al., that it is possible to measure the g-factors of the excited levels of neighboring isotopes with the aid of Coulomb implantation if one of the g-factors is known and if the lifetimes of the various levels are of the same order of magnitude or at least equal to several picoseconds. NSA

N68-25074 Ohio Univ., Athens.

SEARCH FOR A STRANGENESS +2 MESON

Tom Joldersma (Ph.D. Thesis) 1966 78 p Supported by the AEC

Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-1225

The resonance effect is most clearly seen in the 3.0 GeV/c K^+p experiment. Accordingly, the purpose of this dissertation is to increase the data at this momentum in an attempt to determine if the effect is a genuine resonance; and if the effect were genuine, to attempt to determine its spin and parity for comparison with the suggestions of theory. The 80" hydrogen bubble chamber at the 30 GeV/c alternating gradient synchrotron was exposed to a beam of 2.95 GeV/c K^+ mesons. The events were measured on image plane digitizers, reconstructed in space using the TRED program and fit to different hypothesis using the KICK program. No peak in the KK effective mass distribution is observed. The confidence level that the effective mass spectra is described by a simple phase space distribution is equal to 82 per cent. Thus the data does not require the hypothesis of a KK resonance state. The confidence level for agreement with phase space for the combined world data is 72 per cent, removing the suggestion of the $S = +2$ KK meson implied by the original CERN data. Dissert. Abstr.

N68-25078 Ohio Univ., Athens.

SINGLE PION PRODUCTION IN PION–PROTON INTERACTIONS BETWEEN 1 AND 3 GEV

Charles Gordon Howard (Ph.D. Thesis) 1966 165 p

Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-1223

Properties of dipion resonances and pion–nucleon resonances are studied in π^-p and π^+p single pion production interactions between 1 and 3 GeV. Production and decay distributions of the rho and N^{*++} are compared to the predictions of the single particle exchange models. The one-pion-exchange model of Gottfried and Jackson does not explain ρ^0 decay distributions below 1.71 GeV/c. The $T = 0$, S-wave enhancement, ϵ^0 is seen at $\approx$730 MeV in the $\pi^+\pi^-$ effective mass spectrum for all data combined with $\Delta^2/\mu^2 \leq 4$ and $|\cos\theta_{\pi\pi}| < 0.3$. Repopulating the interference region of ρ^+ and N^{*++} with conjugate events is shown to be the most successful method to eliminate this interference for spin density matrix element calculations from ρ^+ decay. Spin density matrix element calculations for N^{*++} decay are compared with the rho exchange model of Stodolsky and Sakurai between 0.91 GeV and 1.25 GeV. Due to the limited π^+p data, the values obtained are not conclusively in agreement or disagreement with the model. Dissert. Abstr.

N68-25080 Michigan Univ., Ann Arbor.
SLOW-NEUTRON SCATTERING AND THE ROTATIONAL DYNAMICS OF MOLECULES
Jon David Erickson (Ph.D. Thesis) 1966 255 p
Available from Univ. Microfilms: HC $11.50/MF $3.30 Order No. 67-1734

Quantum descriptions of slow neutron inelastic scattering cross sections which are sensitive to the presence of internal rotational degrees of freedom in molecules are presented. The details of rotational line shape as affected by the formation and decay of locally ordered structures in polar diatomic liquids are also discussed. Rotational wave functions are derived and examined in the general case. High and low internal barrier approximations suitable for the description of neutron scattering are found for symmetric molecules which are either freely rotating or whose over-all rotations are hindered. New cross section formulae for the scattering by molecular rotational degrees of freedom are obtained using a suitable expansion of the neutron operators. The general quantum line shape formulation of slow-neutron scattering based on the damping theory is reviewed and analysis made of the effect of a position-, orientation-dependent perturbation on the line shape of a hindered rotational line of a polar diatomic liquid.
Dissert. Abstr.

N68-25084 California Inst. of Tech., Pasadena.
RADIATIVE CORRECTIONS TO NEUTRINO-ELECTRON PROCESSES
Mathilde Jeannette Hebb (Ph.D. Thesis) 1967 107 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-434

The lowest order electromagnetic radiative corrections to electron–positron annihilation into neutrino and antineutrino and to neutrino scattering by electrons are calculated. The pair annihilation corrections are used to calculate the radiative corrections to stellar neutrino luminosities in the temperature range in which the zero order process gives the dominant contribution. The corrections to the neutrino–electron scattering cross section are those relevant to a proposed experiment detecting scattered electrons with more than a minimum recoil energy whether or not a bremsstrahlung photon is emitted. It is found that interference between the electromagnetic and weak couplings could depress both the nonrelativistic stellar luminosity and the scattering cross section, but that if the scattering cross section is found to be as large as expected, the luminosity must be also.
Dissert. Abstr.

N68-25116 Michigan Univ., Ann Arbor.
DIFFERENCES BETWEEN π^+p AND π^-p ELASTIC SCATTERING IN THE DIFFRACTION PEAK REGION
Alfred Casimir Saulys (Ph.D. Thesis) 1966 53 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-1798

The differential cross sections of π meson–proton elastic scattering were measured in a spark chamber experiment at incident pion momenta from 2.3 GeV/c to 6.0 GeV/c. The method of analysis of the data and the differences between π^+ and π^- elastic scattering in the diffraction peak region at 2.5, 3.0, and 3.5 GeV/c are discussed. In the course of this experiment approximately 700,000 spark chamber photographs had to be analyzed. For this purpose a cathode ray tube type automatic scanning system was developed, which is described in detail. In comparing the π^+ and π^- elastic scattering in the diffraction peak region it was found that when the differential cross sections for values of the 4-momentum transfer variable t were fitted to an expression of the type Ae^{Bt} in the region $.05 < -t < .6$, the values of B for π^- were slightly but significantly different from those for π^+. It was also found that the ratio of $B(\pi^+)/B(\pi^-)$ agrees within experimental error with the ratio of the total cross sections $\sigma(\pi^+)/\sigma(\pi^-)$ over a wide energy range.
Dissert. Abstr.

N68-25117 California Inst. of Tech., Pasadena.
NUCLEAR BETA SPECTROSCOPY USING SOLID STATE DETECTORS
John Michael Trischuk (Ph.D. Thesis) 1967 80 p
Available from Univ. Microfilms: HC $4.70/MF $3.00 Order No. 67-435

The beta decay shape factor of the 4.8 minute isotope Tl^{207} is measured to be $(.0423 \pm .0006)(1 + (.024 \pm .010)W)$ using solid state detectors. The result is interpreted in terms of the shell model. The properties of the solid state beta spectrometer are described.
Dissert. Abstr.

N68-25132# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
EXPERIMENTAL SITUATION OF π NUCLEON ELASTIC SCATTERING UP TO 2 GEV [SITUATION EXPERIMENTALE DE LA DIFFUSION ELASTIQUE π NUCLEON EN DESSOUS DE 2 GEV]
Pierre Bareyre, Claude Bricman, and Gerard Villet Dec. 1967 65 p refs In FRENCH
(CEA-R-3401)

Experimental data on the π-nucleon elastic scattering have been collected up to 1967 for use in a phase shift analysis. They refer to total cross sections, angular distributions and recoil proton polarizations, for energies less than 1.8 GeV.
Author (NSA)

N68-25133# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik.
CHARACTERISTICS OF VARIOUS ISOTOPES FOR SANDWICH FOIL MEASUREMENTS OF NEUTRON SPECTRA
T. J. Connolly and F. de Kruijf [1968] 11 p refs Presented at the 2d Conf. on Neutron Cross Sect. and Technol., Washington, 4–7 Mar. 1968
(CONF-680307-14) CFSTI: HC $3.00/MF $0.65

The sandwich method involves activation of foils of a single isotope in multiple layers. The difference in specific activity of two such foils can be related to the neutron flux in the narrow energy interval or intervals in which self-shielding occurs. An analysis is made of several isotopes relative to their potential for yielding spectrum information in the 1 to 10^4 eV region via the sandwich technique. The analysis involves an approximate relation giving the activation of individual foils in a multiple-layer stack as a function of the activation of single foils of different thicknesses. Activation in the latter foils is calculated by a standard effective resonance integral analysis. Input information includes both resolved and unresolved resonance parameters. The results give for each isotope the magnitude of the activation difference relative to the total activation of a single foil and also the distribution of this difference between individual resolved resonances and between resolved and unresolved resonances. Independent variables include individual foil thickness, number of foils per sandwich, and the neutron spectrum. Spectra representative of both thermal and fast reactors are included.
Author (NSA)

N68-25136# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Energeticheskii Institut.
RELATIVE PROBABILITIES OF THE EXCITATION OF ISOMERIC STATES DURING RADIATIVE CAPTURE OF THERMAL NEUTRONS [OTNOSITEL'NYE VEROYATNOSTI VOZBUZHDENIYA IZOMERNYKH SOSTOYANII PRI RADIATSIONNOM ZAKHVATE TEPLOVYKH NEITRONOV]
A. V. Malyshev 1967 11 p refs In RUSSIAN
(FEI-79)

The relative probabilities of the formation of isomeric states during the radiation capture of thermal neutrons are calculated on the basis of the statistical theory. The calculations are carried out by a method that takes into account the distribution of the γ-ray sources for each cascade, with the object of verifying the

dependence of the density of nuclear levels on the total angular momentum. On using as an example eight odd-odd nuclei for which the isomeric relations differ by a factor of ≈30, it is shown that on specifying a single parameter of the theory—the density of single-particle states in the neighborhood of Fermi energy—agreement with experiment is achieved within the limits of 50%. Author (NSA)

N68-25137# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Energeticheskii Institut.
TIME AND ENERGY DISTRIBUTION CHARACTERISTICS OF NEUTRONS EMITTED FROM HYDROGEN-CONTAINING RADIATORS. NEUTRON ABSORPTION TIME DISTRIBUTION IN STRONGLY ABSORBING MEDIA [VREMENNYE I ENERGETICHESKIE KHARAKTERISTIKI RASPREDELENIYA NEITRONOV VYLETAYUSHCHIKH IZ A VODORODOSODERZHASHCHIKH RADIATOROV. RASPREDELENIE VREMENI POGOLOSHCHENIYA NEITRONOV V SIL'NO-POGLOSHCHAYUSHCHEI SPREDE]
D. L. Broder, A. A. Kutuzov, and L. P. Kahm'yanov 1967 14 p ref In RUSSIAN

Results obtained using the Monte Carlo method are presented for the case of a neutron source with a Maxwellian spectrum at various thicknesses of moderating radiator. Results are included of the absorption time distribution for neutrons at various energies in layers consisting of a mixture of water and boron. It was found that at the optimum (3 cm) thickness of the water layer, the moderated neutron spectrum virtually coincides with the Fermi spectrum. ^{10}B economies can be attained by addition of water in the cases when some deterioration of the time characteristics is permissible, without fundamentally affecting the efficiency of a detector. Author (NSA)

N68-25152 Michigan Univ., Ann Arbor.
THE SECONDARY MAXIMUM IN PION–PROTON ELASTIC SCATTERING FROM 2.5 GeV/c TO 6.0 GeV/c
Lester Andrew Ettlinger (Ph.D. Thesis) 1966 64 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-1735

The differential cross section for elastic scattering of pions by protons between 2.5 and 6.0 GeV/c has been measured in a spark chamber experiment at the Argonne ZGS. There is a secondary maximum in the differential cross section in the region $.6 < |t| < 2.8$ $(GeV/c)^2$, which decreases smoothly as a function of increasing beam momentum. For a given momentum of the incident pion, the scattering cross sections for π^+p and π^-p at the peak of the second maximum are equal, within statistical errors, in all cases. The pion–nucleon charge exchange cross section is seen to exhibit a secondary maximum at approximately the same value of t and is compared with the elastic scattering distributions. The effect of N resonances on the elastic scattering distributions is discussed. Dissert. Abstr.

N68-25156# Brookhaven National Lab., Upton, N. Y.
NEUTRON CROSS SECTION AND RESONANCE INTEGRALS OF HOLMIUM
Thomas E. Stephenson [1967] 12 p refs Presented at the 2d Conf. on Neutron Cross Sect. and Technol., Washington Sponsored by AEC
(BNL-12269; CONF-680307-11) CFSTI: HC $3.00/MF $0.65

Previously reported calculations were extended. Resonance parameters for 76 resonances of Ho below 500 eV, selected from the literature and from values compiled and recommended in BNL 325, are used as the starting point in fitting the total neutron cross section data to a Breit–Wigner multilevel scattering and single-level absorption formula. The addition of two bound levels, one for each s-wave spin state, yields a calculated ratio of thermal neutron capture cross sections for the two spin states which agrees with experiment (≈60% for J = 3), as does the calculated value of the thermal capture cross section, 67 b. In addition, the two bound levels enable the fit of the total cross section data to be extended to very low energies (0.2 mV). The energy-dependent paramagnetic scattering cross section (23.5 b at 0.0253 eV) and the capture and scattering resonance integrals were also calculated (≈672 and 125 b, respectively). Author (NSA)

N68-25159# Princeton-Pennsylvania Accelerator, Princeton, N. J.
TRANSVERSE AND LONGITUDINAL SPACE CHARGE EFFECTS IN A SYNCHROTRON
K. Prelec 2 Feb. 1968 24 p refs
(Contract AT(30-1)-3217)
(PPAD-637-D) CFSTI: HC $3.00/MF $0.65

The synchrotron theory has been extended by including space charge electric field terms. Results show that in the case of a beam injected with modulated energy there will be in addition to a decrease in betatron frequencies also a beam spreading in radial direction and an increase in synchrotron frequency. Possible effects on particle loss during the injection and capture are discussed. Author (NSA)

N68-25162# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
DETERMINATION OF PLATEAU SLOPE AND ACTIVITY USING FILTER MEASUREMENT RESULTS AND W. CHAUVENENT'S CRITERION (MAGE 2 AND FORTRAN 4 CALCULATION PROGRAMMES) [DETERMINATION DE PENTE DE PALIER ET D'ACTIVITE A PARTIR DE RESULTATS DE MESURE FILTRES SELON LE CRITERE DE W. CHAUVENET (PROGRAMMES DE CALCUL EN MAGE 2 ET FORTRAN 4)]
Antoine Becker Oct. 1967 54 p refs In FRENCH
(CEA-R-3190)

To permit the objective comparison of plateau characteristics of gas-ionization counters, plateaus which are obtained when each radioactive sample from normal LMR production is measured, a program has been drawn up on an electronic computer comprising a processing section using least squares for obtaining the corrected plateaus and energies. With a view to an automatic operation of radio-measurement chains, the program also comprises a preliminary section in which statistical considerations have been applied; this has been done to eliminate measurement results which are dubious and even totally wrong. Author (NSA)

N68-25165# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
STUDY OF THE REACTION $\pi^-p \rightarrow \pi^0n$ AT HIGH ENERGIES (5.9 TO 18.2 GeV/c) AND SMALL FOUR-MOMENTUM TRANSFER [ETUDE DE LA REACTION $\pi^-p \rightarrow \pi^0n$ A HAUTE ENERGIE (5.9 A 18.2 GEV/C) ET FAIBLE QUADRIMOMENT TRANSFERE]
Olivier Guisan (Ph.D. Thesis—Paris Univ., Orsay, France) Nov. 1967 70 p refs In FRENCH
(CEA-R-3209)

The $\pi^-p \rightarrow \pi^0n$ reaction was studied by means of α heavy-plate spark chamber which detected the two photons from the π^0 decay. The methods used for the analysis are presented. In particular it is shown that the obtained events are not contaminated by inelastic processes. The differential cross sections show a pronounced diffraction peak. Its values at 0° are compared, with dispension relation predictions. Among the envisaged theoretical models, the Regge formalism gives a specially good fit to the obtained results. Author (NSA)

N68-25167# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.

NEUTRON SPECTRUM ANISOTROPY IN WATER CLOSE TO AN ABSORBER [ANIZOTROPIYA SPEKTRA NEITRONOV V VODE UBLIZI POGLOTITELYA]

S. N. Ishmaev, I. P. Sadikov, and A. A. Chernyshov 1966 28 p refs In RUSSIAN
(IAE-1216)

An experimental installation based on a linear accelerator was used to measure the space, energy, and angular distribution of neutrons in water near a flat Cd surface. A method is described for measuring stationary neutron spectra with the aid of a chopper rotating in phase with the accelerator starter. The results for measurements of the space relation of the spectra of neutrons proceeding in the opposite directions with respect to the absorber surface show the existence of a strong spectrum anisotropy close to the absorber surface. The results of measurements of the angular dependence of neutron spectrum near an absorber are given. It is shown that the anisotropy of neutron scattering in water exerts a very strong effect on the neutron spectrum at the absorber interface. Author (NSA)

N68-25168# Kaman Aircraft Corp., Colorado Springs, Colo. Nuclear Div.

LONG-LIVED TARGETS

P. L. Jessen [1968] 14 p ref Presented at 3d Intern. Meeting on Accelerator Targets Designed for the Production of Neutrons, Liege, 18–19 Sep. 1967
(KN-67-655(R); CONF-670960-1) CFSTI: HC $3.00/MF $0.65

The development of high yield neutron generators using non-pumped or sealed ion accelerators is discussed. Relative neutron yields from copper, manganese, nickel, and titanium targets bombarded with mixed deuterium and tritium ions are presented. Also, the solubility of hydrogen in these targets is considered since it is an important factor in this method of neutron production. NSA

N68-25182# Shell Research, Ltd., Chester (England). Thornton Research Centre.

CONCERNING ONE METHOD FOR THE EXPERIMENTAL DETERMINATION OF INTERMOLECULAR INTERACTION POTENTIALS

A. B. Kamnev [1967] 11 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III: Fiz.-Astron. (Moscow), v. 6, 1966 p 3–8
(TRANS-1138) CFSTI: HC $3.00/MF $0.65

A description is given of a procedure for determining the interatomic interaction potentials in the range of interaction energies from 0.1 ev to a few electron volts. For determining the interaction potentials, an investigation was made of the elastic scattering of rapid neutral beams with energies from 600 to 4000 ev in gases. Results were obtained for the whole series of noble gases. Theoretical and experimental data are compared. Author

N68-25225# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.

U^{235} FISSION CROSS-SECTION IN THE ENERGY REGION 0.8 TO 170.0 EV [SECHENIE DELENIYA URANA-235 V OBLASTI ENERGII 0.8–170.0 EV]

T. A. Mostovaya 1967 19 p refs In RUSSIAN
(IAE-1302)

The fission cross section of ^{235}U in the energy range from 0.8 to 170 eV was measured by the time-of-flight method with a resolution of 19 nsec/m. It is suggested that in order to detect weak levels, further studies should be done at low temperatures to avoid the Doppler expansion effect. Author (NSA)

N68-25226# California Univ., Livermore. Lawrence Radiation Lab.

NEUTRON SCATTERING CROSS SECTIONS OF U^{233}, U^{235}, AND Pu^{241} FROM 1 TO 30 eV

G. D. Sauter (Calif. Univ., Davis) and C. D. Bowman 28 Feb. 1968 16 p refs Presented at the 2d Conf. on Neutron Cross Sect. and Technol., Washington, 4–7 Mar. 1968
(Contract W-7405-ENG-48)
(UCRL-70826; CONF-680307-9) CFSTI: HC $3.00/MF $0.65

Scattering measurements of ^{233}U, ^{235}U, and ^{241}Pu were made at the Livermore linear electron accelerator using the 4π neutron source technique. Scattering cross sections, corrected for effects of sample thickness, were obtained for neutron energies between 1 and 30 eV. For ^{241}Pu, the scattering cross section and published fission data were simultaneously fitted with Reich and Moore's multilevel formula. A good fit to both cross sections could only be obtained by allowing a sizeable fluctuation in the capture widths. Spin assignments were for all resonances in the 1 to 30 eV interval. The resulting resonance parameters are presented. The results of a similar fit to ^{233}U, was less successful and no spins were obtained. The ^{235}U scattering cross section was not sufficiently detailed for meaningful multilevel analysis. Author (NSA)

N68-25228 Alabama Univ., University.

EFFECT OF THE TWO-PARTICLE SPIN-ORBIT NUCLEON–NUCLEON INTERACTION ON THE O^{16} AND N^{16} NUCLEI

Byron Leonard Coulter (Ph.D. Thesis) 1966 82 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-1320

The odd-parity states of O^{16} and N^{16} nuclei are assumed to be described by a hole in a 0p state and a particle in a 1s or 0d state moving in a harmonic-oscillator potential well. Degeneracies in the energy eigenvalues are removed by a particle–hole interaction consisting of a two-particle central scalar interaction potential with a Serber exchange mixture and a two-particle spin-orbit vector interaction potential. A comparison of theoretical energy level, beta decay, and muon capture calculations with experimental data indicates that the two-particle spin-orbit potential exerts a significant influence on some properties of the O^{16} and N^{16} nuclei. Its use produces an improved theoretical prediction of virtually every feature considered, and, in particular, reasonable predictions of the $2^- \rightarrow 1^-$ beta decay and the $0^+ \rightarrow 1^-$ muon capture were unattainable without the use of the spin-orbit interaction between the particle and hole states. Dissert. Abstr.

N68-25230 Pennsylvania Univ., Philadelphia.

THE DIRAC-SCHWINGER COVARIANCE CONDITION AND APPLICATIONS TO QUANTUM ELECTRODYNAMICS

Stanley Gordon Brown (Ph.D. Thesis) 1966 135 p
Available from Univ. Microfilms: HC: $6.50/MF $3.00 Order No. 67-3055

The first new proof shows that the theorem holds for canonical theories because (1) all field components transform explicitly as tensors; this assures covariance. (2) The simplicity of the commutation relations prevents additional terms from appearing in the energy density commutator. This first proof is valid to lowest order in n or in classical field theory. The second new proof, which is valid to all orders in n in quantum field theory, consists of the direct evaluation of the energy density commutator. The proof is given for the preferred subclass of canonical theories in which products of two or more dependent field components do not appear in the first order interaction Lagrangian; in this subclass, the expressions for dependent field components do not involve roots of field operators or denominators which are operators. In order for the proof to apply to canonical theories outside the preferred subclass, one must set $\partial\hat{\rho}^3(0) = 0$ on symmetry grounds. Dissert. Abstr.

N68-25255# Atomic Energy Establishment, Winfrith (England). Water Reactor Physics Div.

LECTURES ON NEUTRON TRANSPORT THEORY

D. A. Newmarch Apr. 1966 57 p refs

(AEEW-M-676) CFSTI: HC $3.00/MF $0.65

An introduction of the derivation, solution, and application of the neutron transport equation is presented. NSA

N68-25261# California Univ., Livermore. Lawrence Radiation Lab.

SORS MONTE CARLO PHOTON-TRANSPORT CODE FOR THE CDC 6600

John Kimlinger, Ernest F. Plechaty, and John R. Terrall 4 Dec. 1967 44 p refs

(Contract W-7405-ENG-48)

(UCRL-50358) CFSTI: HC $3.00/MF $0.65

The SORS Monte Carlo photon-transport code is a two- or THREE-dimensional program for calculating the transport of photons in the energy range from 1.0 keV to 15.0 MeV. Author (NSA)

N68-25274# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

THE EXCITATION OF BARIUM IONS BY ELECTRON IMPACT Summary Report, 1 Jun. 1965–31 Jan. 1968

F. M. Bacon and J. W. Hooper 1 Feb. 1968 108 p refs

(Contract AT(40-1)-3027)

(ORO-3027-12) CFSTI: HC $3.00/MF $0.65

A crossed-beam technique has been developed for measuring the emission cross section for the excitation of electric dipole transitions in ions by electron impact. The method involves crossing modulated ion and electron beams in a well-defined collision volume. A portion of the photon flux radiated from the excited ions is detected at an angle of 90° to the plane of the two beams by direct observation of the collision volume with a photomultiplier tube. The selection of a single emission line is accomplished with an interference filter. The total flux of radiation from the collision volume for a particular transition can be determined with a knowledge of the photon detection probability of the apparatus. The possibility of an anisotropic angular distribution of radiation from the collision volume is evaluated by measuring the polarization fraction. The emission cross section can be determined from the ion and electron beam currents, current-density distributions and energies, and the total radiation flux. This technique has been used to measure the relative emission cross sections for excitation of the resonance transitions in Ba^+ ions by electron impact. The resonance transitions, between the excited $6^2P_{1/2}$ and $6^2P_{3/2}$ levels and the $6^2S_{1/2}$ ground state, produce photons with wavelengths of 4934 and 4554 Å. The thresholds for exciting the $6^2P_{1/2}$ and $6^2P_{3/2}$ levels are 2.5 and 2.7 eV, respectively. Over the energy range of the experiment, from 8 to 98 eV, the relative cross sections differ by approximately a factor of two, the ratio of the statistical weights of the 6P levels. The relative data also exhibit the high energy dependence predicted by the Bethe–Born approximation. From a best estimate of the photon detection probability of the apparatus, estimated absolute cross sections are obtained, which agree remarkably well in magnitude and shape with the theoretical predictions. Checks on the data were performed to evaluate the possible effects of such parameters as the beam intensities, beam modulation frequency, ion beam composition, ion beam energy, electron beam energy distribution, beam profiles, and signal-to-noise ratio. Author (NSA)

N68-25285*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

TRANSMISSION OF 2.43 MeV ELECTRONS THROUGH THICK SILICON TARGETS

Jag J. Singh 2 Sep. 1967 25 p refs Presented at the Am. Phys. Soc. Meeting, Seattle, 31 Aug.–2 Sep. 1967

(NASA-TM-X-60492) CFSTI: $3.00 CSCL 20H

The energy and angular distribution of electrons transmitted through silicon targets of various thicknesses were measured for normally incident electrons of energy 2.43 MeV. The transmitted electron spectra were measured with 5 mm deep Si(Li) detectors. The effects of secondary electrons and photons besides the effects of ionization energy loss fluctuations are also considered. The inclusion of these effects in the theoretical calculations has improved the agreement between the theory and the experiment considerably. The electron diffusion length in silicon at 2.43 MeV was measured to be (2.50 ± 0.10) mm. Author

N68-25307# Commissariat a l'Energie Atomique, Chuscian (France). Centre de Production de Plutonium de Marcoule.

DECONTAMINATION TESTS ON TRITIUM-CONTAMINATED MATERIALS [ESSAIS DE DECONTAMINATION DE MATERIEL CONTAMINE PAR DU TRITIUM]

Pierre Boutot and Pierre Schipfer Dec. 1967 18 p In FRENCH

(CEA-R-3312)

These tests are designed to try out various processes to be applied to the decontamination of a material contaminated with tritium. The samples are thin stainless-steel slabs contaminated in the laboratory with elements extracted from industrial installations. The measurement of the initial and residual activities is carried out using an open-window BERTHOLD counter. The best results are obtained by passing a current of pre-heated (300°C) air containing water vapor. This process makes it possible to reach a decontamination factor of 99.5% in 4 hours. In a vacuum, the operation has to be prolonged to 100 hours in order to obtain a decontamination factor of 99.2%. Wet-chemical or electrolytic treatments are efficient but their use is limited by the inherent corrosion risks. A study of the reappearance of the contamination has made it possible to observe that this phenomenon occurs whatever the process used. Author (NSA)

N68-25308# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

DIFFUSION OF EXTREMELY DILUTE CONCENTRATIONS OF URANIUM IN β–TITANIUM AND γ–IRON [DIFFUSION DE L'URANIUM EN DILUTION INFINIE DANS LE TITANE β ET LE FER γ]

Francois de Keroulas (Ph.D. Thesis—Paris Univ., Orsay, France) Jul. 1967 52 p refs In FRENCH

(CEA-R-3253)

A method based on the recording of fission fragments in insulators, allowing the study of uranium concentrations in metals about 10^4 to 10^5 lower than those possible by autoradiography of ^{235}U is described. This method has been used to study the diffusion of uranium (concentration between 10^{-7} and 10^{-8}) in β titanium and in γ iron. The diffusion coefficients obey the equation: $D = D_0 \exp(-H/kT)$ with $D_0 = 2.10^{-3}$ cm^2 s^{-1} and H = 1.43 eV/at. for titanium and $D_0 = 7.10^{-5}$ cm^2 s^{-1} and H = 1.38 eV/at. for iron. In titanium there is a distinct increment of diffusion when the allotropic transformation is reached; it appears to be due to the point defects created by the transformation. Author (NSA)

N68-25309# Fiat S.p.A., Turin (Italy). Sezione Energia Nucleare.

SQUID-360: A MULTIGROUP DIFFUSION PROGRAM WITH CRITICALITY SEARCHES FOR THE IBM-360

A. Daneri, B. Gabutti, and E. Salina Brussels EURATOM Feb. 1968 127 p

(Contract EURATOM-089-66-2 TEEI)

(EUR-3882.E)

The two-dimensional diffusion program SQUID-360, which is written in Fortran IV for the IBM-360/65, is described. The one-line Chebyshev semi-iterative method is used to solve the finite difference equations. The program features the solution of non-homogeneous problems, solution of adjoint problems, three types of criticality searches, and restart of interrupted problems. NSA

N68-25314 Duke Univ., Durham, N. C.
THE SCATTERING OF 1.0 AND 2.4 MEV POLARIZED NEUTRONS FROM HELIUM
James Richard Sawers, Jr. (Ph.D. Thesis) 1966 164 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-3025

Precision angular distributions of the asymmetry in the scattering of 1.0 and 2.4 MeV polarized neutrons from helium were determined. The reactions $Li^7(p,n)Be^7$ and $C^{12}(d,n)N^{13}$ served as neutron sources and target thicknesses of 46 and 175 keV respectively were used. Analyzing angles ranged from 30° to 140° in 10° increments. A spin precession solenoid was employed and the helium was contained in a high pressure scintillation cell. Neutrons scattered through the desired scattering angle were detected with plastic scintillators. Recorded backgrounds were minimized by accepting only helium recoil counts, which satisfied specific energy requirements and which were coincident with the neutrons detected in the plastic scintillators. A Monte Carlo program was written for calculating the effects on the observed asymmetry of multiple scattering in the helium cell. Results from this code also allowed the data to be corrected for the effects of the finite geometry of the helium cell and the neutron detectors. Dissert. Abstr.

N68-25320# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
CONTRIBUTION TO THE STUDY OF THERMAL MIXING BETWEEN NUCLEAR SPIN SYSTEMS [CONTRIBUTION A L'ETUDE DU MELANGE THERMIQUE ENTRE SYSTEMES DE SPINS NUCLEAIRES]
Maurice Goldman 1967 113 p refs In FRENCH
(CEA-R-3290)

Methods of dynamic nuclear polarization in solids based on the thermal mixing between nuclear spin systems are described. The description of the thermal mixing procusses involves most of the fundamental aspects of the spin temperature theory. The experiments, conducted with paradichlorobenzene and paradibromobenzene, yield a detailed confirmation of the theoretical predictions. Author (NSA)

N68-25348 Maryland Univ., College Park.
CALCULATION OF THE GROUND STATE POPULATIONS AND SELF-ENERGIES IN THE OPTICAL PUMPING OF HYDROGEN AND THE ALKALI VAPORS
Michael Eugene Pittman (Ph.D. Thesis) 1966 104 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-2347

The first part of this dissertation is a study of the alignment and orientation of the ground state hyperfine populations of hydrogen and the alkali vapors under the action of optical pumping. The second part is a study of the "lamp" or light-intensity shift in hydrogen. It is shown that if one tries to pump optically a hydrogen maser even with unpolarized light of relatively low intensity, then a measurable lamp shift is to be expected. Even the use of hydrogen itself as a source introduces asymmetries due to the finite ground state hyperfine splitting. Dissert. Abstr.

N68-25350# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
DIRECT AND INVERSE PHOTONUCLEAR REACTIONS ON ^{15}N AND ^{15}O NUCLEI [PRYAMYE I OBRATNYE FOTOYADERNYE REAKTSII NA YADRAKH ^{15}N I ^{15}O]
M. A. Zhusupov and R. A. Eramzhyan 1968 17 p refs In RUSSIAN Submitted for publication
(JINR-P4-3674)

Direct and inverse photonuclear reactions on mirror ^{15}N and ^{15}O nuclei are considered in terms of a particle-hole approach taking into account the pair correlations of nucleons in nucleus. A wide maximum of the dipole transitions (in the range of 20 to 21 and 25 to 26 MeV) as well as "pigmi" resonances in the range of 20 MeV are given. Isospin structure of the resonance is studied. The "pigmi" resonance is due to the excitation of the states with $T = 1/2$, while the main maximum is due to the states with $T = 3/2$. The decay scheme of the dipole states of ^{15}N nucleus is calculated. It is shown that the contribution of a three-particle channel of disintegration is rather large. The inverse reactions $^{14}N(p,\gamma)^{15}O$ and $^{14}C(p,\gamma)^{15}N$ emitting γ-quanta both into the ground and $I = 3/2^-$ excited state of ^{15}N and ^{15}O nuclei, are investigated. The resonances have different structure in these mirror nuclei. Author (NSA)

N68-25351# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
ON THE NONLINEAR THEORY OF A HYDRODYNAMIC BEAM INSTABILITY, 2 [K NELINEINOI TEORII GIDRODINAMICHESKOI PUCHKOVOI NEUSTOICHIVOSTI, 2]
V. G. Makhan'kov and B. G. Shchinov 1968 8 p refs In RUSSIAN Submitted for publication
(JINR-P9-3690)

The effect of the nonlinear interaction of harmonic on the quasi-linear relaxation of an aperiodic beam instability is estimated. Author (NSA)

N68-25353# Gulf General Atomic, San Diego, Calif.
INTEGRAL NEUTRON THERMALIZATION Quarterly Progress Report, Period Ending 31 Dec. 1967
J. R. Beyster, G. M. Borgonovi, and T. Gozani 15 Jan. 1968 46 p refs
(Contract AT(04-3)-167)
(GA-8449) CFSTI: HC $3.00/MF $0.65

Theoretical studies included the completion of tests of scattering laws for diphenyl and for zirconium hydride based on force constant models. A model for UO_2, similar in many respects to the zirconium hydride model, is nearing the testing stage. The first principles calculation of beryllium lattice dynamics has been completed. Other theoretical work includes improvements to the DSZ code for calculation of slowing-down sources. Plans are given for angular measurements from single beryllium crystals that will provide a severe check of theoretical models incorporating coherent effects. Analysis of total cross section data for water in terms of the parameter T was carried out. The resultant T agrees with the value calculated from the Haywood II phenomenological water kernel. The sensitivity of the results of kinetic studies in ^{238}U to inelastic neutron scattering was investigated by comparing experimental results to calculations with simplified Monte Carlo code. NSA

N68-25360# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
EVALUATION OF ^{185}RE AND ^{187}RE NEUTRON CROSS SECTIONS FOR THE ENDF/B LIBRARY
W. B. Henderson and J. W. Zwick [1967] 32 p refs Presented at the 2d Conf. on Neutron Cross Sect. and Technol., Washington, D. C., 4–7 Mar. 1968
(Contract AT(40-1)-2847)
(GEMP-587; CONF-680307-1) CFSTI: HC $3.00/MF $0.65

The neutron cross sections of ^{185}Re and ^{187}Re from 10^{-5} to 1.5×10^7 eV were evaluated and placed in the ENDF/B library format. The cross sections in the energy range 10^{-5} and 10^2 eV are described by resonance parameters reported by Friesenhahn et al., except for bound levels, where parameters were assigned to fit the measured cross sections at thermal energies using multi-level Breit–Wigner calculations. In the range 10^2 to 10^5 eV the cross sections are described by unresolved resonance parameters for s- and p-wave contributions, and a smooth correction cross section is used to compensate for omission of higher-order contributions. In the range 10^5 to 1.5×10^7 eV smooth cross

sections are given which were obtained for the most part from optical model calculations using parameters which produce good agreement with the inelastic, radiative capture, and (n,2n) cross sections, as well as reactivity worth and absorption integrals, were also used to evaluate the parameters in the nuclear models, the results from which were then supplied as the evaluated cross sections. Author (NSA)

N68-25398# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON THE CHARGE DEPENDENCE OF THE THREE-NUCLEON NUCLEI RADII [O ZARYADOVOI ZAVISIMOSTI RADIUSOV TREKHNUKLONNYKH YADER]
S. B. Gerasimov 1968 6 p refs In RUSSIAN Submitted for publication
(JINR-P2-3705)

The charge dependence of the distribution radii of "odd" nucleons (the proton for ^{3}He and the neutron for ^{3}H) in the three-nucleon nuclei is discussed for the cross section of the ^{3}He and ^{3}H nuclear photodisintegration on the basis of the dipole sum rule and the model of the isotopic invariance violation. The result is compared with experiment. Author (NSA)

N68-25399# United Kingdom Atomic Energy Authority, Culham (England). Translation Office
X-RAY AND OPTICAL MEASUREMENT ON TOKOMAK TM-3
D. A. Shcheglov Oct. 1967 10 p refs Transl. into ENGLISH of Gos. Kom. Po Izpol'zovaniyu At. Energii, Moscow, Rept.-IAE-1406, Jul. 1967 p 1–12
(NP-TR-1624; CTO-438; IAE-1406)

Information about the electron distribution function in the Tokomak is obtained by X-ray and optical measurements, and various questions arising in this connection are discussed. Author (NSA)

N68-25405# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
VECTOR DOMINANCE MODEL AND THE SUM RULES FOR THE HIGH ENERGY INTERACTION [MODEL VEKTORNOI DOMINANTNOSTI I PRAVILA SUMM DLYA γ P-VZAIMODEISTVIYA PRI VYSOKIKH ENERGIYAKH
S. B. Gerasimov and V. A. Serdyutskii 1968 11 p refs In RUSSIAN Submitted for publication
(JINR-P2-3704)

In the framework of the vector dominance model for the hadron electromagnetic interaction the sum rule is obtained connecting the γ p-interaction cross section with the constant of the photon-vector transition and with the parameters of the high energy meson-nucleon scattering. The value of the constant obtained from the sum rule is compared with the data of various experiments. Author (NSA)

N68-25406# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON THE UNIQUENESS OF THE SOLUTION OF THE EQUATIONS FOR THE "PARTIAL" AMPLITUDES IN THE RELATIVISTIC THREE-PARTICLE PROBLEM [OB ODNOZNACHNOSTI RESHENIYA URAVNENII DLYA "PARTSIAL'NYKH" AMPLITUD V RELYATIVISTSKOI ZADACHE TREKH CHASTITS]
D. Ts. Stoyanov 1968 8 p refs In RUSSIAN Submitted for publication
(JINR-P2-3694)

The uniqueness of the solution of the equations for the partial amplitudes in the three-particle problem was proved. The equations of these amplitudes and the amplitudes themselves were previously derived for the relativistic case by Stoyanov and Shelest. Author (NSA)

N68-25407# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
GAMMA-RADIATION OF ^{69}Ge [GAMMA-IZLUCHENIE ^{69}Ge]
Ya. Vrzal, B. S. Dzhelepov, Ya. Liptak, L. N. Moskvin, V. P. Prikhodtseva et al 1968 12 p refs In RUSSIAN
(JINR-P6-3698)

The γ-ray spectrum from the decay of ^{69}Ge was measured using the Ge(Li) detector whith a volume of about 12 cm^3. The energies and the intensities of γ transitions as well as the values of log ft were determined. The more complete decay scheme is constructed. Author (NSA)

N68-25410# Academy of Sciences (USSR), Moscow. Inst. of Atomic Energy.
CASCADE EXCITATION OF THE HYDROGEN ATOM DURING PASSAGE ACROSS A PLASMA TARGET [KASKADNOE VOZBUZHDENIE ATOMA VODORODA PRI PROKHOZHDENII CHEREZ PLAZMENNUYU MISHEN']
D. P. Grechukhin and E. I. Karpushkina 1967 60 p refs In RUSSIAN
(IAE-1364)

The cascade excitation of a hydrogen atom passing through plasma is analyzed. The following cases are considered: (a) the plasma exists in a magnetic field resulting in the ionization of highly excited states of the atom; (b) there is no magnetic field in the plasma. The calculations are intended to elucidate the principal characteristic features of the cascade process and to estimate the possibilities for utilizing this excitation mechanism in the injection of neutrals into magnetic traps. The "fast flight" method is used to estimate the ionization cross sections of highly excited atoms of hydrogen due to ionization by fields of the atom, ion, electrical dipole and quadrupole. NSA

N68-25417# Academy of Sciences (USSR), Moscow.
FILM-TYPE SCINTILLATION DETECTOR FOR MEASUREMENT OF THE TOTAL NUMBER OF CAPTURES IN THE RESONANCES OF THE (n,γ) REACTION [STSTINTILLYATSIONNYI DETEKTOR NA PLENKAKH DLYA IZMERENIYA POLNOGO CHISLA ZAKHVATOV V REZONANSAKH REAKTSII (N,γ)]
L. S. Danelyan 1967 12 p refs In RUSSIAN
(IAE-1349)

With the aid of the film-type scintillation detector, which displays a constant recording effectiveness with respect to the (n,γ) capture reaction from resonance to resonance, it is shown that the relative magnitudes of the total number of captures in resonances, required to calibrate the intensities of partial gamma-transitions from levels of the nucleus ^{155}Gd+n, are determined by means of the NaI(Tl) crystal with a satisfactory accuracy (no worse than 5%). Author (NSA)

N68-25427# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
GAMBIT USER'S MANUAL
W. H. Gray and G. Collier Feb. 1968 133 p refs
(WANL-TME-1751)

Input instructions, sample problems, and the computer code are presented for use with GAMBIT program in calculating multigroup neutron cross sections in the high energy and thermal energy ranges. A.L.

N68-25431*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MEASUREMENT OF ENERGY ABSORPTION IN OMNIDIRECTIONAL PHOTON FLUXES
Fearghus O'Foghludha (Med. Coll. of Va.) and Emanuel Rind [1967] 28 p refs Presented at the Va. Acad. of Sci., Norfolk, Va., 3 May 1967
(NASA-TM-X-60495) CFSTI: HC$3.00/MF$0.65 CSCL 20H

A quick and versatile technique has been experimentally developed for measuring average dose from spatially distributed gamma radiation in a mass system, i.e., a body organ or the body itself. The technique and resulting data within statistical error are in agreement with King's reciprocity theorem. Experimental data also show that although the theorem ignores photon scattering, it is still valid. The technique is being extended to neutron produced doses. The experimental equipment is described and experimental results are presented. Author

N68-25443# General Dynamics Corp., San Diego, Calif. General Atomic Div.

DCALC: A SUBROUTINE FOR ONE DIMENSIONAL NEUTRON DIFFUSION THEORY CALCULATIONS

M. R. Wagner 17 Oct. 1967 85 p refs
(Contract AT(04-3)-167)
(GA-8286) CFSTI: HC $3.00/MF $0.65

The one-dimensional neutron diffusion theory routine DCALC, which is shared by the FEVER-7, GASP-7, and TEMCO-7 programs, is described. The methods that are used to solve the multigroup difference equation are outlined, and a FORTRAN listing of the subroutine is included. NSA

N68-25452# California Univ., Livermore. Lawrence Radiation Lab.

PARTICLE OPTICAL CHARACTERISTICS OF AN ELECTROSTATIC DEFLECTOR IN A MAGNETIC FIELD

Rolf W. Mueller Oct. 1966 16 p refs Transl. into ENGLISH from Z. Angew. Phys. (W. Berlin), v. 18, 1965 p 342–345
(UCRL-TRANS-10214) CFSTI: HC $3.00/MF $0.65

The most important particle-optical properties of an electrostatic deflector, which also rotates the particle pulse in a direction perpendicular to the direction of the field, were calculated on an analog computer. NSA

N68-25461 Alabama Univ., University.

THE STUDY OF THE ROLE OF THE GRAVITATIONAL FIELD IN QUANTUM FIELD THEORIES AND OF SOME PROPERTIES OF A DIRAC PARTICLE IN A GRAVITATIONAL FIELD

Vitalij Garber (Ph.D. Thesis) 1966 73 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-1286

The role of the gravitational field in quantum field theories is investigated by requiring the quantum field theory to be generally covariant under the generalized inhomogeneous Lorentz field under this group, using the concept of local measurement, and working in the Lagrangian formalism, it is shown that the usual gravitational field variables (in vierbein form) arise as c-number quantities if the equivalence principle is invoked. Further arguments for the c-number gravitational field are given, and the relationship of the gravitational field to quantum fields indicated. Starting from the variational principle, the modified Klein–Gordon and Dirac equations are derived. Dissert. Abstr.

N68-25463 Pennsylvania Univ., Philadelphia.

PION EXCHANGE EFFECTS IN NUCLEAR WEAK INTERACTIONS

Wen-Kwei Cheng (Ph.D. Thesis) 1966 81 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-3057

The nature of pion-exchange effects in nuclear weak interactions is studied. As is well-known, in the conventional theory of nuclear beta-decay, the effective Lagrangian of the weak interactions is taken as a sum of terms each of which refers to the effective Lagrangian of weak interactions describing the beta-decay of a single (physical) nucleon on its mass shell; it is clear that in such an approach meson-exchange terms in the effective weak-interaction Lagrangian, which necessarily depend on distances between pairs of nucleons, are neglected entirely. It is, therefore, not very surprising that highly accurate quantitative predictions of beta-decay rates are not attained in the conventional theory even in cases where it is believed that the wave functions of the initial and final nucleus are sufficiently well known. Thus, it is an important and interesting theoretical problem to see whether a careful consideration of meson-exchange effects can be carried out and whether, as a result of such a consideration, certain existing discrepancies between calculated and measured beta-decay rates can be minimized. Dissert. Abstr.

N68-25469 Pennsylvania State Univ., University Park.

PROPERTIES OF THE LOW LYING STATES IN Ru 99 AND Ru 101, INCLUDING THE LIFE-TIME AND MAGNETIC MOMENT OF THE 127 KEV STATE IN Ru 101

Phillip Irving Connors (Ph.D. Thesis) 1966 76 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-1915

The properties of the low lying states of ruthenium^{99} (Ru^{99}) and ruthenium^{101} (Ru^{101}) populated in the β-decay of their rhodium (Rh) parents were studied and compared to the predictions of de Shalit's core excitation model. The states in Ru^{101} fed by the decay of Rh^{101} ground state ($\approx$5 yr) were studied by both electron and gamma ray spectroscopy. Three transitions were found (gamma ray intensities in parenthesis): 127.2$\pm$0.2 keV (93); 198.0$\pm$0.3 keV (100), and 325.2$\pm$0.5 keV (21). The absolute K-conversion coefficients of the 127.2 and 198.0 keV transitions were measured to be 0.14$\pm$7% and 0.040$\pm$7% respectively. The angular correlation coefficient of the 198.0–127.2 keV transitions was determined to be $A_2 = 0.22 \pm 10\%$. The half life of the 127.2 keV state was found to be 0.63$\pm$0.03 nsec. When combined with the Coulomb excitation data of Ritter et al., the M1-E2 mixing ratio, δ^2, of the 127.2 and 198.0 keV transitions are 0.023$\pm$0.005 ($\delta > 0$) and $\leq$0.06 ($\delta < 0$), respectively. Dissert. Abstr.

N68-25495# Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica.

SOME NONLINEAR EFFECTS IN ELECTRON CYCLOTRON RESONANCE DISCHARGES

W. J. Schrader Oct. 1967 79 p refs
(NP-17361; Rept.-67-40)

Nonlinear effects near cyclotron resonance in the interaction of standing electromagnetic waves with electrons of a magnetized plasma are studied theoretically and two experiments in which these effects occur are described. The effects are radio-frequency confinement, the influence of relativistic mass variations, and that of velocities parallel to the constant magnetic field. A treatment is given of the motion of an electron in a magnetic field B_0 and an electromagnetic standing wave with polarization perpendicular to B_0. The treatment of the rf confining force embodies a comparison with the force caused by a gradient of the constant magnetic field. Detailed calculations of oscillation energy and beating frequency between electron motion and electric field are also given for many values of electric and magnetic field. Finally, a treatment of the complete three-dimensional motion with an application to energy gain during a reflection by the electromagnetic field along the constant magnetic field is given. Author (NSA)

N68-25497# Joint Inst. for Nuclear Research, Dubna (USSR) Lab. of Theoretical Physics.

α–α SCATTERING FOR THE CASE OF NON-LOCAL FACTORIZING INTERACTION [α–α RASSEYANIE V SLUCHAE NELOKAL'NOGO FAKTORIZUYUSHCHEGOSYA VZAIMODEISTVIYA]

F. Tkebuchava and G. Chilashvili 1968 7 p refs In RUSSIAN Submitted for publication
(JINR-P4-3717)

Alpha–alpha scattering is investigated taking into account the Coulomb interaction for the case of a nonlocal factorizing potential. The parameters of the interaction potential are found from the phase-shift analysis using the experimental values of the S phase in the interval E =0.2 to 10 MeV. Author (NSA)

N68-25556 Pennsylvania Univ., Philadelphia.
SYMMETRIES AND WEAK INTERACTIONS
Tapaskumar Das (Ph.D. Thesis) 1966 121 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-3062

In this work we investigate the internal symmetry properties of weak interactions, in which leptons also play an active role. Since SU(3) works so well for the hadrons, it is interesting to speculate on whether an SU(3)-theory of weak interactions can be constructed including the leptons. We have also studied the possibility of higher symmetry schemes for weak interactions. Regarding the higher symmetry schemes we have shown that symmetry schemes higher than SU(3) are not at all natural and at least they do not serve any particularly useful purpose. We have treated the rank 3 group, Sp(6) extensively as a good representative example. On the other hand we have found that an SU(3) theory of weak interactions including leptons can be constructed; all CP-invariant weak interactions can be put in a single framework which at the same time exhibits some intrinsic symmetry-structure of weak interactions. In order to put leptons into irreducible representations of SU(3), we have postulated the existence of two charged heavy leptons so as to have two SU(3)-triplets corresponding to the muonic and the electronic leptons. Dissert. Abstr.

N68-25559# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
SUPERCONVERGENCE RELATIONS FOR NUCLEON PLUS ANTINUCLEON YIELDS PION PLUS RHO MESON AND NUCLEON PLUS ANTINUCLEON YIELDS PION PLUS OMEGA MESON
A. Bartl (Tubingen Univ.) and F. Widder (Graz Univ.) Nov. 1967 12 p refs
(DESY-67/38)

Superconvergence relations for $\bar{N}+N\rightarrow\pi+\rho$ and $\bar{N}+N\rightarrow\pi+\omega$ are considered which follow from high-energy behavior. Saturating these relations with a number of low-lying states one obtains $g_{\rho N}/g_{\omega N}\cong 0.06$, and $m_\omega=m_\rho$ and $g_{\rho\pi\pi}=21$ (GeV)-1 in good agreement with experiment. Assuming ρ-meson universality and vector meson dominance one obtains $g_{\rho N}=2.8$, $g_{\omega N}=6.4$, $f_{\rho N}=10.3$ in agreement, and $f_{\omega N}=4.0$ in disagreement with the results of a least-squares fit of low-energy N–N data. Author (NSA)

N68-25560 Missouri Univ., Columbia.
STUDIES IN ATOMIC ABSORPTION
Samuel Roy Koirtyohann (Ph.D. Thesis) 1966 147 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-2860

The long path atomic absorption method suggested by Fuwa and Vallee was studied for the determination of fifteen elements in materials of interest in biology and agriculture. The method is quite sensitive, and is very useful for the determination of a number of the more volatile elements such as zinc, cadmium, thallium, mercury, lead, and copper. For elements which form stable compounds in the flame, competing reactions deplete the atomic population and limit the usefulness of the method. Background absorption by molecular species in the flame was studied in the long path and conventional atomic absorption methods. Bands due to molecules such as MgOH, CaOH, SrO, and LaO, which are well known from emission flame work, are also observed in absorption. These bands produce spectral interferences on the atomic absorption lines of several elements. Molecular absorption is the primary cause for the small interfering light losses that are encountered in atomic absorption, rather than scattering by particles as was previously believed. The observed losses do not conform to the appropriate light scattering theory. Author

N68-25580*# Florida Univ., Gainesville.
AN APPROXIMATE MO-LCAO-SCF METHOD INCLUDING OVERLAP
Rolf Manne 15 Jun. 1966 28 p refs *Its* Preprint No. 85
(Grant NsG-512)
(NASA-CR-83496) CFSTI: HC $3.00/MF $0.65 CSCL 20H

A molecular orbital method is described which can be applied to molecules where the restrictions of π-electron theory are not fulfilled. It has the following main characteristics: (1) atomic SCF functions are used as a basis; (2) core-valence interactions are treated by means of perturbation theory; and (3) Mulliken type approximations are used for many-center integrals. Author

N68-25584# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.
MULTIPLE MESON PRODUCTION IN PROTON–NUCLEON INTERACTIONS AT 22.6 AND 24 GEV/C
Shun-ichi Hasegawa (Waseda Univ., Tokyo), Hirotada Nanjo (Waseda Univ., Tokyo), Takeshi Ogata (Kwansei Gakuin Univ., Nishinomiya), Michinori Sakata (Nagoya Univ.), Kojiro Tanaka (Waseda Univ., Tokyo) et al Mar. 1968 63 p refs
(RIFP-68) CFSTI: HC $3.00/MF $0.65

The inelastic interaction of 22.6 and 24 Gev/c protons with free or quasi-free nucleons in nuclear emulsion are studied by using an external beam of the CERN proton synchrotron. A total of 1656 interactions are found according to a systematic scanning. The resulting mean free path is 37.2±1.5 cm at 22.6 Gev/c and 37.6±1.2 cm at 24 Gev/c. The mean number of shower particles per event is 5.6±0.3 at 22.6 Gev/c and 5.6±0.2 at 24 Gev/c. The present analysis has been made for 209 events with $N_h\leq 1$ and $K_M\leq 1.4$. When the events are divided into two groups, $n_s\geq 7$ and $n_s\leq 6$, the angular distribution of shower particles is carefully analyzed. The smaller multiplicity events are sharply peaked forward and backward in the center of mass system such that the degree of anisotropy is larger for smaller multiplicity events. Whilst for larger multiplicity events the angular distribution tends to be more isotropic in the center of mass system. There seems to be evidence of the production of some intermediate products, through which mesons are emitted in an isotropic way in its rest system. A possible interpretation of such intermediate products is considered. Author

N68-25598# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
VERY WEAK MODEL OF THE VIOLATION OF PC [LE MODELE SUPERFAIBLE DE LA VIOLATION DE PC]
M. Gourdin Mar. 1968 20 p refs In FRENCH Presented at Seminar at the 3rd Moriond Meeting on Electromagnetic Interactions, Lac-de-Tignes, France, 9–19 Mar. 1968
(TH/68/12) CFSTI: HC $3.00/MF $0.65

The disintegration of neutral K-mesons and a system of two pi-mesons were studied, particularly in terms of the impact of the discrete symmetries of TCP or time reversals. It is noted that even if the theoretical aspects of the violation of PC have remained unchanged, the experimental studies have resulted in new data particularly with regard to leptonic modes. The very weak theory proposed by Wolfenstein in 1964 is discussed, and a model is defined based on this theory. Relationship to unitarity was considered, as

were the asymmetry of the disintegration and interference spectra, violation within the interference spectra, and final states. Transl. by M.W.R.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N68-24381# Academy of Sciences (USSR), Moscow.
PLASMA INSTABILITY AND COMPENSATION OF THE ION BEAM SPACE CHARGE [PLAZMENNYE NEUSTOICHIVOSTI I KOMPENSATSIYA PROSTRANSTVENNOGO ZARYADA IONNOGO PUCHKA]
M. V. Nezlin 1966 43 p refs
(IAE-1277)

The mechanism of strong variable electric field formation is analyzed for an ionic beam whose space charge is compensated by electrons formed by the beam in a rarefied gas. The nature of plasma instabilities responsible for dynamic beam decompensation was investigated experimentally. New methods are proposed for controlling the instabilities. The results obtained are claimed to be applicable to all physical installations utilizing intense ion beams in a strong magnetic field, e.g., electromagnetic isotope separators and plasma traps with external fast ion injection. Author (NSA)

N68-24433 Texas Univ., Austin.
BREAKDOWN MECHANISMS FOR LASER-INDUCED PLASMAS IN SUPER-HIGH PRESSURE GASES
Dennis Howard Gill (Ph.D. Thesis) 1966 136 p Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-3283

Possible mechanisms responsible for laser-induced breakdown in super-high pressure gases are investigated both theoretically and experimentally. It is shown that the breakdown mechanism involves energy gain of free electrons by acceleration in the incident electromagnetic field while undergoing collisions with neutrals, and subsequent electron-impact ionization. This mechanism is described by classical microwave breakdown theory and favorably compares with the experimental measurements. Experimental breakdown threshold data in He, Ar, H_2 and N_2 was obtained over the pressure range 100–30,000 psi. Two possible mechanisms are evaluated: multiquantum absorption and electron-impact ionization. The latter is analyzed both quantum mechanically by the inverse bremsstrahlung theory and classically by microwave theory. The agreement between experiment and theory is good. All four of the gases investigated experimentally exhibited definite minima in their breakdown curves, indicative of electron-impact ionization. Dissert. Abstr.

N68-24435# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
HYDROMAGNETIC COUPLING OSCILLATIONS IN NON-UNIFORM, COLLISIONLESS PLASMAS
Tsutomu Tamao Mar. 1968 30 p refs *Its* Vol. 33, No. 4
(ISAS-422, V. 33, No. 4) CFSTI: HC $3.00/MF $0.65

The main object in the present paper is to study the thermal effects on resonant coupling hydromagnetic oscillations in inhomogenuous, low-β plasmas, such as the earth magnetosphere. Applying the drift kinetic approximation the fundamental equations for the coupling modes between the Alfven and magnetosonic oscillations in a non-uniform, collisionless plasma are obtained. There are two thermal effects for such oscillations, the thermal dissipation due to wave-particle resonance interactions and the drift effect from plasma inhomogeneities. For the outer magnetospheric conditions, where $\beta \simeq m_e/m_i$, it is shown that electron thermal dissipation of hydromagnetic oscillations with $\omega/k_\parallel \simeq V_A$ is most effective within the resonance regions which appear in the cold plasma limit. This effect is proportional to ω/Ω_i for the case of continuous distribution of plasma parameters and $(\omega/\Omega_i)^2$ for the stratified distribution, respectively where Ω_i is the ion gyrofrequency. Attenuation of hydromagnetic waves due to ion-wave interaction may be a possible process for ion heating in the plasma sheet of the geomagnetic tail and relevant equations are also derived. With a view to applying the results to the magnetospheric plasma, drift wave instabilities in long wave length limit are discussed for the most general case, including simultaneously the density, temperature and magnetic field gradients, as well as the ion Larmor radius effect. Author

N68-24449 Missouri Univ., Columbia.
ANOMALOUS CHARACTERISTICS OF DISCHARGES IN MERCURY–POTASSIUM VAPORS
Vernold Karl Feiste (Ph.D. Thesis) 1966 90 p Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-2855

The research reported is an attempt to determine if the Penning effect may be observed in a thermionic diode containing mercury and small admixtures of potassium. Anomalously high currents due to an efficient two-stage ionization process were first observed in discharge studies in a gas containing neon and small amounts of argon by Penning. Small amounts of argon, called the seed material, were introduced into neon. The argon was almost completely ionized by low energy collisions with neon metastables. A necessary condition for this type of two-stage ionization is that the ionization potential of atoms of the seed material be just below the excitation potential of a metastable state in atoms of the matrix gas. Such a condition is met by potassium seed in mercury vapor as well as by argon seed in neon gas. The probability of the excited atom transferring energy to ionize atoms of the seed material is much greater in matrix gases whose atoms have appropriate energy long lifetime metastable excited states than for normal excited states of appropriate energy. Dissert. Abstr.

N68-24459*# Scripta Technica, Inc., Washington, D. C.
CURRENT HEATING OF PLASMA IN A CLOSED MAGNETIC TRAP [TOKOVYY NAGREV PLAZMY V ZAMKNUTOY MAGNITNOY LOVUSHKE]
P. Ya. Burchenko, B. T. Vasilenko, Ye. D. Volkov, R. M. Nikolayev, V. A. Potapenko et. al Washington NASA May 1968 7 p refs Transl. into ENGLISH from the Publ. "Vzaimodeystviye Zaryazhennykh Chastits S Plazmoy" Kiev, Naukova Dumka Press, 1967 p 132–138
(Contract NASw-1694)
(NASA-TT-F-11629) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Experimental investigation of the effect of accelerated electrons on plasma characteristics in a closed magnetic trap. The experiments consisted of measurement of the current flow, plasma density, X-ray radiation, microwave radiation, and light emission as a function of the accelerated particle density. Author

N68-24495# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.
ELECTRON CYCLOTRON WAVES IN THE PLASMA WAVEGUIDE [ELEKTRONNYE TSIKLOTRONNYE VOLNY V PLAZMENNOM VOLNOVODE]
B. I. Patrushev, V. P. Gozak, and D. A. Frank-Kamenetskii 1966 32 p refs In RUSSIAN
(IAE-1244)

Experimental investigation of the distribution of electron cyclotron waves in plasma along a magnetic field in a magnetic mirror system is reported. The spatial distribution and alternating field distribution of the wave was measured with a magnetic probe. The aspects studied included penetration of the uhf wave into plasma, ionization and heating of plasma upon injection of neutral gas, heating of injected plasma, x radiation of plasma, spatial concentration distribution, effect of probes, particle and energy lifetimes, and the apparent and real resonance width. It was shown

that the wave concentrates in the waveguide. The most efficient energy absorption and electron heating occur under the conditions of cyclotron resonance in the inhomogeneous magnetic field domain. Electron temperatures of several hundred eV were attained at electron concentrations of the order of 5×10^{11} cm^{-3}. To explain the observed processes of the uhf wave interaction, a working hypothesis envisages that, as a result of collective interactions, the wave entering the plasma is transformed into noise with an expanded and displaced spectrum and directionally uniform field distribution. NSA

N68-24541# Boeing Co., Seattle, Wash. Plasma Physics Lab.
PENETRATION OF A HIGH-FREQUENCY FIELD IN A LOW-PRESSURE PLASMA
M. J. Kofoid and H. V. Cleva Jan. 1968 47 p refs
(DI-82-0706)

Comparisons between calculated and directly measured values of radial penetration of axially-directed magnetic fields in cylindrical plasmas have been effected. Using small-amplitude elementary theory the curve of field intensity vs radius was calculated which matched the measured intensity at the axis. In this calculation the degree of variation of conductivity vs radius was taken as that determined from the measured electron temperature T_e and density n_e. The level of conductivity demanded by theory was then compared with that deduced directly from the measured n_e and T_e. Author

N68-24571*# Sperry Rand Research Center, Sudbury, Mass.
ULTRA-HIGH TEMPERATURE MEASURING TECHNIQUES Final Report
P. J. Freyheit, K. J. Nygaard, D. Norcross, and P. M. Stone May 1968 140 p refs
(Contract NAS12-86)
(NASA-CR-86055; SRRC-CR-68-17) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Development of a real-time technique for measuring gas temperatures above 5000°K in an air nitrogen plasma was investigated using an air plasma in the temperature range from 5,000°K to 24,000°K at light densities in the range from 10 times normal to 10^{-6} times normal. The temperature measurement techniques considered were Doppler line broadening, line intensity ratios, line-to-continuum intensity ratios, and measurement of particle density with subsequent calculation of temperature. Two methods, line intensity ratios and Doppler broadening, covered the range adequately. A real-time temperature measuring system employing these methods would use photomultiplier tubes as detectors and incorporate an independent means (e.g., Stark broadening) of measuring electron density. In investigations of a hot cesium seeded hydrogen plasma, the influence of cesium seed fraction on the cesium-hydrogen plasma photoabsorption coefficient was determined over the pressure range from 0.1 to 100 atmospheres. Spectroscopic techniques for measuring the temperature of hot cesium seeded hydrogen were also analyzed, and a procedure for determining temperature using the Stark broadened width, line center absorption coefficient, and emission energy of selected lines is presented. Author

N68-24586# Minnesota Univ., Minneapolis. Inst. of Technology.
INVESTIGATIONS OF IONIC SPECIES IN HIGH PRESSURE CESIUM DISCHARGES Annual Report, 1 Mar. 1967–29 Feb. 1968
Lorne M. Chanin 29 Feb. 1968 44 p refs
(Contract N00014-67-A-0113-002)
(AR-2; AD-666970)

Measurements are reported of ion species present in active rf and dc plasmas of argon and cesium. Comparison is made of data obtained using ion extraction through the anode and cathode of a dc plasma with measurements made using rf excitation of the plasma. Author (TAB)

N68-24608# Joint Publications Research Service, Washington, D. C.
INVESTIGATIONS ON CONTROLLED THERMONUCLEAR REACTIONS IN THE USSR
I. N. Golovin, B. B. Kadomtsev, and V. T. Tolok *In its* Soviet Atomic Sci. and Eng. 13 May 1968 p 270–291 (See N68-24602 14-22)

An overview is presented on the methods under development by the physicists of 20 countries for achieving a slow, controlled thermonuclear reaction. These varied techniques for creating, heating, and confining plasmas include columns of cold plasma and toroidal discharges, injectors for fluxes of fast atoms and plasma jets, turbulent heating and the heating of plasmas by ion cyclotron resonances, the discovery of traps with magnetic plugs, and closed traps of toroidal type. The production of power is cited as an important reason for developing thermonuclear reactors. Stress is placed on the need for accumulating the data necessary for predicting the behavior of a high temperature plasma in a magnetic field before serious consideration is given to the production of a magnetic thermonuclear reactor. Also noted are the benefits resulting from the international exchange of information. M.G.J.

N68-24621# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
PLASMA CONFINEMENT IN GENERAL ATOMIC TOROIDAL OCTOPOLE
Masaji Yoshikawa, Tihiro Ohkawa, and Arthur A. Schupp 14 Jun. 1967 30 p refs Sponsored jointly with Tex. Atomic Energy Res. Found.
(GA-8141) CFSTI: HC $3.00/MF $0.65

Plasma confinement in the toroidal octopole device is described. The octopole field is produced by four current-carrying rings which are held by supporting rods. A toroidal field may also be applied. The plasma is injected from a coaxial gun. The density is variable from 10^{8} to 10^{13} cm^{-3} and the ion and electron temperatures are approximately 100 eV and 6 eV, respectively. Measurements are performed by neutral and ion analyzers and electrostatic and magnetic probes. The ion confinement time depends on the plasma density. At densities higher than 10^{11} cm^{-3}, the high-energy ions are lost in tens of microseconds by charge–exchange interaction with the gas released by plasma bombardment near the injection window. For the plasma with densities below 10^{11} cm^{-3}, the ion confinement time is several hundreds of microseconds at 100 eV. The decay is consistent with the loss on the supporting rods. The decay rate is orders of magnitude less than the rate estimated from the fluctuation amplitudes in the plasma and at least an order of magnitude less than predicted from the Bohm diffusion coefficient. Author (NSA)

N68-24683# United Kingdom Atomic Energy Authority, Culham (England).
SOME OBSERVATIONS ON THE FLOW OF A TENUOUS PLASMA IN A MAGNETIC FIELD
D. W. Atkinson and J. A. Phillips Dec. 1967 11 p refs
(CLM-R-72) HMSO: 1s 9d

A coaxial gun is used to inject plasma, particle density $\approx 10^{10}$ to 10^{11}/cm^3 and velocity $\approx 5 \times 10^7$ cm/sec into a longitudinal magnetic field of 780 gauss. Properties of the plasma as it flows down the magnetic field are examined by diamagnetic loops. It is suggested that an apparent loss of transverse energy is not real, but that parts of the plasma jet are accelerated by electric fields produced by the space charge separation of ions and electrons. Author (NSA)

N68-24726# United Kingdom Atomic Energy Authority, Culham (England). Research Group.
GRAVITATIONAL AND DRIFT WAVES IN A PERIODIC SLAB
K. Rohlena and J. D. Jukes Jan. 1968 16 p refs
(CLM-R-83) CFSTI: HC $3.00/MF $0.65

The low frequency electrostatic drift-acoustic mode and the gravitational flute mode in a periodic gravitational field in a collisionless plasma are examined. As a model, a one-dimensional plasma slab with straight field-lines, a small density gradient and a perpendicular gravity periodic along the field lines is considered. Only the long wavelength non-localized waves are investigated. The periodicity along the field-lines causes the modes to combine producing unstable hybrid modes or standing waves. The energy transfer between the resonant electrons and the waves is also examined. Author

N68-24736# California Univ., Livermore. Lawrence Radiation Lab.
BURNOUT BY NEUTRAL INJECTION IN A TORUS
E. J. Lauer 14 Dec. 1967 10 p refs
(Contract W-7405-ENG-48)
(UCID-15298) CFSTI: HC$3.00/MF$0.65

Mathematical relations are described for the density of hot and cold ions and of H_2 gas molecules. NSA

N68-24740# Boeing Co., Seattle, Wash. Plasma Physics Lab.
ANOMALOUS SKIN EFFECT IN A GASEOUS PLASMA
Melvin J. Kofoid Jan. 1968 17 p refs
(D1-82-0705)

Experimental data are presented for the skin effect in a plasma in which the electron thermal motions are sufficient to increase the field penetration. The results are consistent with the Weibel criteria for the existence of anomalous penetration and with the theoretical anomalous penetration depth. Author

N68-24747# Sydney Univ. (Australia). School of Physics.
NONLINEAR EFFECTS IN THE PROPAGATION OF LARGE AMPLITUDE ALFVEN WAVES IN A LABORATORY PLASMA
R. C. Cross and C. N. Watson-Munro Dec. 1967 24 p refs
(NP-17346; ER-27)

In a cylindrical hydrogeneous laboratory plasma source of diameter 21 cm and length 170 cm, the propagation of Alfven torsional waves of azimuthal wave field b_ϕ propagating parallel to a steady magnetic field B_0 in the z direction was studied. The perturbation ratio b_ϕ/B_0 was increased to values as high as 2.6 and it was found that: (a) As the perturbation ratio is increased the wave rapidly steepens into a shock wave, but at perturbation ratios in excess of 1.2 there is no further reduction in the rise time of the leading edge. (b) The Alfven Mach Number shows a marked reduction in rate of increase at this perturbation ratio. (c) The attenuation of the wave increases rapidly at this perturbation ratio. (d) evidence was obtained of the attenuation energy being expended in particle heating and in the development of a higher-frequency magnetoacoustic wave traveling radially outwards in the plasma. Author (NSA)

N68-24752# Sydney Univ. (Australia). School of Physics.
INTERFERENCE OF CHARACTERISTIC WAVES IN PLASMAS
G. F. Brand and C. A. Hooker Nov. 1967 14 p refs
(NP-17342; ER-33)

The interference between the two characteristic waves in a magnetized plasma has been studied for propagation both parallel and perpendicular to the magnetic field. A new microwave interferometer which has been used to measure electron densities is described. Besides having a simpler construction, it is more sensitive than existing interferometers in certain situations. Author (NSA)

N68-24775# Sydney Univ. (Australia). School of Physics.
SIX-MONTHLY PROGRESS REPORT, 1 JULY–31 DECEMBER 1967
31 Dec. 1967 11 p
(NP-17332; MPR-14)

Brief summaries of research are given on the following topics: plasma sources, JXB fronts, compressional wave studies, large amplitude Alfven waves, microwave reflection and propagation, and lasers. NSA

N68-24800# Rheinisch-Westfalische Technische Hochschule, Aachen (West Germany). Institut fuer Mechanik.
ELECTRON DIFFUSION AND RADIATION FROM STRONG SHOCK WAVES [ELEKTRONENDIFFUSION UND STRAHLUNG AUS SEHR STARKEN STOSSWELLEN]
H. Groenig and G. Linke Feb. 1968 66 p refs In GERMAN; ENGLISH summary
(BMWF-FB-W-68-12) CFSTI: HC$3.00/MF$0.65

The simulation of high velocity shock waves around reentry bodies seems rather expensive for conventional shock tubes. To overcome this difficulty a device has been set up with the aim to accelerate shock waves electromagnetically. This was achieved by an inverse pinch arrangement resulting in a cylindrical discharge which produced stable, cylindrical shock waves with almost constant velocity. The shock Mach numbers obtained are of the order 20 to 200 with the initial pressure between 2 and 0.02 Torr. There is very good agreement between the measured radial velocity and the results of the snow plow theory. The shock structure may be qualitatively explained by a diffusion-model and the Ramsauer-effect. The experiments included the measurement of the magnetic field, the light front, the pressure, and the electrical field. Author

N68-24826# Princeton Univ., N. J. Plasma Physics Lab.
POSSIBLE CAUSE OF PLASMA TURBULENCE IN A HIGH CURRENT TOROIDAL DISCHARGE
M. M. Larionov and V. V. Rozhdestvenski Feb. 1968 12 p refs Transl. into ENGLISH from Russian Rept.
(Contract AT(30-1)-1238)
(MATT-TRANS-53) CFSTI: HC$3.00/MF$0.65

It is shown that under the discharge conditions, turbulent phenomena in the plasma are caused by the development of convective instability, and this type of instability limits further increase in the plasma temperature. NSA

N68-24830# Sydney Univ. (Australia). School of Physics.
MICROWAVE INTERFEROMETRY FOR PLASMAS AND A NEW METHOD FOR DETERMINING COLLISION FREQUENCY
G. F. Brand and C. A. Hooker Oct. 1967 24 p refs
(NP-17340; ER-30)

Electron densities and collision frequencies of a plasma are measured by a microwave interferometer using circularly polarized waves propagating parallel to the magnetic field. The collisionless approximation to the refractive index gives accurate estimates of the average electron density $\langle n \rangle \simeq 1/l \int_0^l n(z)dz$ over several orders of magnitude. The numbers of observable fringes on interferograms taken over a range of magnetic fields gives a new and sensitive method for determining the collision frequency and its dependence on the electron density. Effects of small nonuniformities in the magnetic field are important at fields for which the electron cyclotron frequency $\approx$ the wave frequency. Author (NSA)

N68-24835# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
STUDY OF DENSE-PLASMA PROPERTIES USING VERY HIGH-FREQUENCY ELECTROMAGNETIC WAVES (LIGHT WAVES) [ETUDE DES PROPRIETES DES PLASMAS DENSES AU MOYEN D'ONDES ELECTROMAGNETIQUES DE TRES HAUTE FREQUENCE (ONDES LUMINEUSES)]

Claude Gormezano (Ph.D. Thesis—Paris Univ.) 1967 136 p refs In FRENCH
(CEA-R-3125)

A study is made of methods based on the following use of lasers for measuring the electronic density and temperature of dense plasmas ($N_e > 10^{15}$ e/cm^3): an interferometric method using a gas laser, based on the properties of the Perot–Fabry cavities; and a method making use of the 90° scattering produced by the plasma on light emitted by a ruby laser. These methods have been applied to various dense plasmas: high-frequency plasma torch, azimuth compression, and plasma bursts produced by focusing a laser beam on a metal target. The measurements have also been carried out using conventional methods of diagnosis. It has thus been possible to measure densities of between 5×10^{15} and 10^{19} e/cm^3 and temperatures of between 3 and 10 eV. These different methods are then compared. Author (NSA)

N68-24897# Sydney Univ. (Australia). School of Physics.
PROPAGATION OF CIRCULARLY POLARISED WAVES IN A MAGNETISED LABORATORY PLASMA
G. F. Brand and C. A. Hooker Oct. 1967 16 p refs
(NP-17341; ER-31)

The propagation of circularly polarized microwaves parallel to the magnetic field is studied in a laboratory plasma. It is shown that Appleton's equation gives an adequate account of the observations. Author (NSA)

N68-24898# United Kingdom Atomic Energy Authority, Culham (England).
THE LONGITUDINAL MAGNETIC FIELD IN THE SIRIUS RACETRACK STELLARATOR
O. V. Biryakov, A. V. Georgievskii, V. E. Ziser, L. Kh. Kitaevskii, and V. T. Tolok [1967] 4 p refs Transl. into ENGLISH from At. Energ. (Moscow), v. 23, Aug. 1967 p 134
(NP-TR-1619; CTO-434) CFSTI: HC $3.00/MF $0.65

Calculations made of the longitudinal magnetic field in the "Sirius" stellarator are briefly summarized. NSA

N68-24910# Gulf General Atomic, San Diego, Calif.
SESH: A FORTRAN 4 CODE FOR CALCULATING THE SELF-SHIELDING AND MULTIPLE SCATTERING EFFECTS FOR NEUTRON CROSS SECTION DATA INTERPRETATION IN THE UNRESOLVED RESONANCE REGION
F. H. Froehner 3 Jan. 1968 90 p refs
(Contract AT(04-3)-167)
(GA-8380) CFSTI: HC $3.00/MF $0.65

The computer program SESH, which uses Monte Carlo methods to calculate resonance self-shielding and multiple scattering effects as required for the interpretation of neutron capture and self-indication data in the region of unresolved resonance, is described. The program also calculates average transmissions for the analysis of neutron transmission data in the region of unresolved resonances. The calculations are based on level statistics. An example of a SESH calculation is given, as is a listing of the SESH code. NSA

N68-24911# United Kingdom Atomic Energy Authority, Culham (England).
ANOMALOUS RESISTANCE OF THE PLASMA IN TOKOMAK TM-3
G. A. Bobrovskii, K. A. Razumova, and D. A. Shcheglov [1967] 9 p refs Transl. into ENGLISH from the Rept. IAE-1408
(NP-TR-1617; CTO-437) CFSTI: HC $3.00/MF $0.65

A hydrogen discharge with high energy input per particle is investigated. In Tokomak TM-3 it is found that the transverse energy of the plasma determined from the diamagnetic effect, is significantly higher than the electron temperature calculated from the electron conductivity. An analysis of the soft X-ray spectrum confirms the existence of high temperature electrons in the plasma, and the phenomenon is discussed. Author (NSA)

N68-24912# United Kingdom Atomic Energy Authority, Culham (England).
TOROIDAL CONFIGURATIONS WITH NEGATIVE "V" AND SHEAR OF THE MAGNETIC FIELD LINES
C. Gourdon, D. Marty, and M. Vuillemin Oct. 1967 22 p refs Transl. into ENGLISH from CEA-FC-411 Rept.
(NP-TR-1621; CTO-441) CFSTI: HC $3.00/MF $0.65

The comparative investigation of the structure of the magnitic surfaces in the neighborhood of the magnetic axis as a function of l ($l = 2$, $l = 3$, $l = 4$) led one to the choice of octupole geometries ($l = 4$) as the only ones providing simultaneously an average magnetic well (of relative depth $\approx a/R$) and considerable shear of the magnetic lines of force. The octupole-based investigation of the influence of the pitch of the helical conductors ($m = 1,3,4,5$) on the value of the rotational transform and the shear ratio is discussed. NSA

N68-24986# Princeton Univ., N. J. Plasma Physics Lab.
STUDY OF PLASMA COMPRESSION OF THE "TRUMAN" UNIT
V. V. Afrosimov, A. B. Berezin, V. Ye. Golant, I. P. Gladkovskiy, V. A. Ipatov et al Feb. 1968 25 p refs Transl. into ENGLISH from Russian report
(Contract AT(30-1)-1238)
(MATT-TRANS-52) CFSTI: HC $3.00/MF $0.65

Experiments have been conducted in the adiabatic compression of plasma in a magnetic field of the toroidal type. The preliminary heating of the plasma was done by toroidal discharge. Before compression the concentration of the plasma was 1.2×10^{14} cm^{-3}, and the temperature was 6 to 10 eV. Compression was realized by increasing the magnetic field from 0.5 to kOe in 20 μsec. According to the optical measurements, the "light" radius of the plasma decreases by 3 to 4 times during compression. The concentration of the plasma inside the column increases by 5 to 7 times during compression according to the corpuscular measurement data. As has been shown by experiments on super-high-frequency location of the plasma, one observes a sharp decrease in the plasma concentration in the vicinity of the diaphragm. Author (NSA)

N68-24994 Ohio State Univ., Columbus.
STUDIES OF A TENUOUS CROSSED-FIELD PLASMA CONTAINED IN A MAGNETIC BOTTLE
Richard Jennings Colchin (Ph.D. Thesis) 1966 169 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-2427

A plasma was formed in a cylindrical chamber 10 cm in diameter. The pressure in the chamber was maintained at 10^{-4} mm Hg by an automatically controlled gas leak system. A wire on the axis was held at voltages in the vicinity of −700v. A magnetic field of the bottle or mirror shape was impressed in the longitudinal direction. Typical magnetic fields were of the order of 50 to 200 gauss. The distance between the magnetic mirrors was 31.5 cm. Ion currents in the neighborhood of 100 μa were collected by the center wire. Only a small number of electrons reached the outer chamber walls. Most electrons were lost through the magnetic mirrors, the greater number at radii near the outside of the plasma. A relatively small number of ions were lost at the ends. Dissert. Abstr.

N68-25001 Michigan Univ., Ann Arbor.
EXPERIMENTS ON CHARGED QUANTIZED VORTEX RINGS IN HE 2

George Gamota (Ph.D. Thesis) 1966 141 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-1743

The results are reported for two experiments on charged quantized vortex rings in superfluid helium: a direct measurement of the size of the rings as a function of their energy, and a study of the interactions of oppositely charged beams of quantized vortex rings at various temperatures. The conclusions show: (a) the size measurement supports the (perhaps surprising) hypothesis that classical equations can be applied to the behavior of quantized microscopic entities; (b) the interaction experiment at low temperatures leads to a determination of a vortex–vortex interaction cross section; and (c) at higher temperatures, a threshold temperature is found which can be interpreted to mark a switch-over from the vortex ring to the free ion domain. Dissert. Abstr.

N68-25015# Sydney Univ. (Australia). School of Physics.
THE PROPAGATION OF TRANSVERSE ELECTROMAGNETIC WAVES NEAR TO ELECTRON CYCLOTRON RESONANCE IN A MAGNETISED LABORATORY PLAMSA
G. F. Brand and C. A. Hooker Jun. 1967 9 p refs
(NP-17339; ER-29)

Experimental observations of the propagation of circularly polarized waves in a plasma parallel to the magnetic field are described. A new method for determining the collision frequency and finding its dependence on the electron density is presented. Author (NSA)

N68-25016# United Kingdom Atomic Energy Authority, Culham (England). Research Group.
ECONOMIC GENERATION OF POWER FROM THERMONUCLEAR FUSION
R. Carruthers, P. A. Davenport, and J. T. D. Mitchell Oct. 1967 33 p refs
(CLM-R-85) HMSO: 4s 6d

Plasma confinement systems are examined as to their potential for satisfying plasma power balance requirements for electrical power generation from the D–T fusion reaction. From this analysis a steady-state toroidal system is taken as a model and engineering parameters are identified defining (i) the form and size of an economic fusion reactor; and (ii) the plasma confinement parameters which must be satisfied. Capital and generation costs for a power station based on this model are estimated and it is shown that the generation costs compare favorably with those from other possible energy sources. A similar study of a D–D reactor indicates that this could provide an economic power source though the confinement parameters are more stringent. These economic studies are used to identify technological problems requiring investigation. Author (NSA)

N68-25031# United Kingdom Atomic Energy Authority, Culham (England).
EXPERIMENTAL INVESTIGATION OF A TOROIDAL DISCHARGE IN A VARIABLE LONGITUDINAL MAGNETIC FIELD
D. P. Ivanov [1967] 9 p refs Transl. into ENGLISH from Russian
(NP-TR-1622; CTO-450) CFSTI: HC $3.00/MF $0.65

Measurements were made of the diffusion coefficient in the Tokomak range of toroidal devices. Brief discussions of the techniques and results are presented. NSA

N68-25035# Sydney Univ. (Australia). School of Physics.
MAGNETOHYDRODYNAMIC WAVE MODES BEHIND NORMAL IONIZING SHOCK WAVES
R. C. Cross, R. A. Gross, B. W. James, and C. N. Watson-Munro Dec. 1967 10 p refs
(NP-17347; ER-35)

The distribution of current loops that develop behind strong ionizing shock waves in a coaxial electromagnetic tube has been studied experimentally and found to be similar to modes excited by two dimensional magnetohydrodynamic waves. Author (NSA)

N68-25036# Sydney Univ. (Australia). School of Physics.
REFRACTION OF MICROWAVES OBLIQUELY INCIDENT ON A PLASMA SLAB
G. F. Brand and C. A. Hooker Nov. 1967 13 p refs
(NP-17343; ER-34)

A preliminary experiment has been conducted on the refraction of microwaves which are incident at an arbitrary angle on a plane, parallel-sided slab of magnetized plasma. The main features of the experimental results are adequately described when Appleton's equations, for propagation at an angle to the magnetic field, are applied to a simple plasma model. Author (NSA)

N68-25056# Sandia Corp., Albuquerque, N. Mex.
MEASUREMENTS WITH A RADIO-FREQUENCY PLASMA IMPEDANCE BRIDGE
Robert W. Harris Feb. 1968 19 p refs
(Contract AT(29-1)-789)
(SC-RR-68-30) CFSTI: HC $3.00/MF $0.65

A low-density plasma impedance bridge has been constructed and calibrated. The active arm of the bridge consists of two radio-frequency coils driven at 500 kc. The presence of plasma in one coil changes the effective impedance of the coil and thus destroys the bridge balance, producing an output signal, the amplitude and phase of which depend on the plasma density and temperature. The bridge was calibrated first by inserting metal rods of various diameters into the sensing coil to produce known changes in the flux threading the coil. The bridge was also used to study plasma pulses from a coaxial rail gun. The results of amplitude and phase measurements indicated plasma electron densities in the range from 1 to 3×10^{10} cm $^{-3}$ and temperatures of about 3000°K. The density determination is in rough agreement with a density determination by another method. Author (NSA)

N68-25090*# Minnesota Univ., Minneapolis. Heat Transfer Lab.
THERMAL ANALYSIS OF CATHODE AND ANODE REGIMES OF AN MPD ARC Summary Report, Jun. 1965–Jan. 1967
K. T. Shih, E. Pfender, and E. R. G. Eckert Jan. 1968 118 p refs
(Contract NAS3-2595)
(NASA-CR-54864; HTL-TR-70) CFSTI: HC $3.00/MF $0.65
CSCL 20I

A new test chamber which was incorporated into an existing arc tunnel test facility was especially designed and constructed for anode heat transfer studies in MPD-arc configurations. Three different axially symmetric anode designs of the same overall dimensions were used in the experimental program, namely a solid anode, a longitudinally segmented anode and an axially segmented anode. Anode heat transfer and current distribution data were taken over a wide range of parameters (arc current, mass flow rate, pressure, magnetic field strength, cathode position) using argon and ammonia as working fluids. The experimental results show that there is a linear relationship between the anode heat fluxes and the arc currents corresponding to a proposed heat transfer model for the anode. The current and heat flux distribution determined with an axially segmented anode is found to be affected by the mass flow rate, the magnetic field strength and the cathode position. Author

N68-25147 Maryland Univ., College Park.
EXPERIMENTAL OBSERVATIONS OF THE STRUCTURE OF SHOCK WAVES IN A COLLISION-FREE PLASMA
George Charles Goldenbaum (Ph.D. Thesis) 1966 92 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-2007

Radial Shock waves are generated in a 10 cm diameter cylindrical hydrogen plasma. The initial conditions are $kT_e = 1.4$ eV, $n \approx 2 - 3 \times 10^{14}$ cm^{-3}, $B_{oz} = 650$G. Shock waves with an Alfven Mach number of about 3 are generated by a fast rising axially directed field of amplitude +5 kG. Magnetic probe measurements show that the thickness of the magnetic transition is about 1 cm. Spectroscopic observations of the appearance of lines from carbon impurities in the plasma indicate that the electrons are rapidly heated to 50 eV or more in the leading edge of the magnetic transition. The electrons are heated in a time short compared with the deflection time for electron–ion collisions. The transition takes place over a length shorter than the ion gyroradii, the ion–ion or the ion–neutral mean free path for ions in the wave front. These results agree with a simple model in which the electrons are heated in front of the observed magnetic disturbance and the structure of the magnetic field transition is determined by collisions of the electrons with ion waves, or by an ion wave instability. Dissert. Abstr.

N68-25176*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE SELECTION OF SIMPLE MODEL ATOMS FOR CALCULATIONS OF ELECTRON DENSITY IN NONEQUILIBRIUM, LOW TEMPERATURE CS PLASMAS
John V. Dugan, Jr. 22 Mar. 1967 11 p refs Presented at the 27th Ann. Conf. for Phys. Electron., Cambridge, Mass., 20–22 Mar. 1967
(NASA-TM-X-59780) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Values are obtained for a Maxwellian distribution of free electrons; this distribution was shown to be a good approximation for $T_e > 2100$°K in optically thick Cs plasmas. The sensitivity of N_e to the choice of electronic levels, statistical degeneracy and radiative capture coefficients is presented for plasmas either optically thin or thick to resonance radiation. The steady state equation for the electron number density is discussed in the limits of low and high neutral density. A discussion of rules for choosing reasonably accurate but simple atomic models is included. Those electronic levels which serve as free electron source terms are identified as functions of N_{Cs} for fixed T_e. Even a 5-level model gives N_e values which are only in fair agreement with optically thick results for a 26-level model under certain conditions. The lumped level degeneracy g_M can be made a function of N_{Cs} and T_e to bring the M = 5 results into better agreement with the more reliable M = 26 results of Norcross and Stone. However, in the absence of such a comparison it does not appear that construction of accurate but simple atomic models is a straightforward process. Author

N68-25235# Princeton Univ., N. J. Plasma Physics Lab.
CORRELATION STUDY OF A PENNING DISCHARGE
A. B. Berezin, D. G. Bulyginskii, M. I. Vil'dzhyunps, and V. A. Rodichkin Feb. 1968 22 p refs Transl. into ENGLISH from Russian Rept.
(Contract AT(30-1)-1238)
(MATT-TRANS-51) CFSTI: HC $3.00/MF $0.65

The spectrum of the oscillations of fluctuations of electric fields in a Penning discharge plasma is obtained, and its relationship to the field distribution in chutes provided for in the theory of drift gradient instability X_0 is established. In addition, the coefficient of turbulent diffusion is obtained for this discharge with the help of the correlation function. The experimental material indicates that the correlation analysis is a fruitful method of investigation of both the macroscopic characteristics of discharge and special features of it connected with the specific form of instability of the plasma in crossed fields. Author (NSA)

N68-25246*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE SELECTION OF SIMPLE MODEL ATOMS FOR CALCULATIONS OF ELECTRON DENSITY IN NONEQUILIBRIUM, LOW TEMPERATURE CS PLASMAS
John V. Dugan, Jr. Washington 1967 12 p refs Presented at the 27th Ann. Conf. for Phys. Electron., Cambridge, Mass., 20–22 Mar. 1967, Sponsored by MIT
(NASA-TM-X-52291) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Free electron number densities N_e are calculated for cesium plasmas with low electron temperatures T_e(0.15–0.3 eV) using 5-, 3-, and 2-level atomic models. These N_e values are obtained for a Maxwellian distribution of free electrons; this distribution was shown to be a good approximation for $T_e > 2100$°K in optically thick Cs plasmas. The sensitivity of N_e to the choice of electronic levels, statistical degeneracy and radiative capture coefficients is presented for plasmas either optically thin or thick to resonance radiation. The steady state equation for the electron number density is discussed in the limits of low and high neutral density N_{Cs}. The ionization fraction $f = N_e/N_{Cs}$ was studied as a function of N_{Cs} for the range of T_e from 1740°K (0.15 eV) to 3000°K. Results are presented as a function of T_e for $N_{Cs} = 3 \times 10^{22}$ m^{-3} (typical values for certain thermionic diodes). Both sets of results are compared with the corresponding Saha curves for plasmas in local thermodynamic equilibrium (LTE). A discussion of rules for choosing reasonably accurate but simple atomic models is included. Author

N68-25250 Ohio State Univ., Columbus.
INVESTIGATION OF ELECTRIC ARC INTERACTION WITH AERODYNAMIC AND MAGNETIC FIELDS
Ward Charles Roman (Ph.D. Thesis) 1966 296 p Available from Univ. Microfilms: HC $13.50/MF $3.80 Order No. 67-2530

A general critique of the literature showed that in spite of voluminous studies, the actual physical interaction between an electric arc, gas flow, and external magnetic field is still undefined because of the lack of a suitable mathematical model to simulate the actual phenomenon. Therefore, a detailed experimental study was conducted on the basic interaction phenomena and fundamental energy exchange mechanism of a high current electric arc at atmospheric pressure held fixed in an aerodynamic field by a transverse external magnetic field. This interaction features the essential characteristics of such magnetically driven arcs as are utilized in high temperature arc heaters. Dissert. Abstr.

N68-25402# United Kingdom Atomic Energy Authority, Culham (England). Translation Office.
INVESTIGATION OF IONIZATION OF HYDROGEN IN TOROIDAL ELECTRIC FIELDS WITH MICROWAVES
H. Beerwald Nov. 1967 48 p refs Transl. into ENGLISH of Kernforschungsanlage, Juelich Rept.-Jul-480-pp, Apr. 1967 p 1–51
(NP-TR-1630; CTO-444; Jul-480-pp) CFSTI: HC $3.00/MF $0.65

Measurements were made on electron multiplication which occurs when a weakly ionized collisional hydrogen plasma is subjected to a sufficiently strong toroidal electric field. To measure electron densities corresponding to neutral particle densities of the order of 10^{16} cm^{-3}, microwave interferometry is suitable. NSA

N68-25404# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy
THE EFFECT OF ION-ION COLLISIONS ON THE NONLINEAR LANGMUIR WAVE INTERACTION IN PLASMA [VLIYANIE ION-IONNYKH STOLKNOVENII NA

NELINEINOE VZAIMODEISTVIE LENGMYUROVSKIKH VOLN V PLAZME]
V. G. Makhan'kov and B. G. Shchinov 1968 17 p refs In RUSSIAN Submitted for publication
(JINR-19-3689)

The effect of the ion-ion collisions on the nonlinear Langmuir wave interaction in nonisothermal ($T_e >> T_i$) entirely ionized plasma has been considered. It is shown that at definite plasma parameters the sequential transformation can essentially change the nature of the nonlinear spectral energy transformation even for not very intensive Langmuir oscillations. Author (NSA)

N68-25411# Academy of Sciences (USSR), Moscow. Inst. of Atomic Energy.
INTERACTION BETWEEN ION FLUX AND TARGET PLASMA DURING CHARGE EXCHANGE [VZAIMODEISTVIE IONNOGO POTOKA S PLAZMOI MISHENI PRI PEREZARYADKE]
K. B. Kartashev, V. I. Pistunovich, and E. A. Filimonova 1967 20 p refs In RUSSIAN
(IAE-1400)

The interaction between a homogeneous plasma in the absence of a magnetic field and an ion flux in which the ion temperatures differ in the transverse $T_\perp$ and longitudinal $T_\parallel$ directions with respect to the directional velocity $\vec{u}$ of ions is considered. The effect of the temperature anisotropy of the ion flux on the stability of oblique waves in plasma is elucidated and a comparison with the previously considered cases of isotropic distribution is presented. NSA

N68-25441# United Kingdom Atomic Energy Authority, Culham (England). Translation Office.
ELECTRICAL CONDUCTIVITY OF A PLASMA IN A STRONG MAGNETIC FIELD
B. B. Kadomtsev and O. P. Pogutse Oct. 1967 15 p refs Transl. into ENGLISH of Gos. Kom. Po Izpol'zovaniyu At. Energii, Moscow, Rept.-IAE-1416, Jul. 1967 p 1-19
(NP-TR-1623; CTO-428; IAE-1416)

It is shown that in a strong magnetic field, when the cyclotron frequency of the electrons is greater than their Langmuir frequency, on passing a longitudinal current with directed velocity $u = j/en_0$ which is smaller than the thermal velocity $v_e = \sqrt{T_e/m_e}$, the observed anomalous resistance, in the strictest sense of the term, is small; the conductivity decreases only by a value of the order of $\delta\sigma/\sigma \sim u/v_e$. However, in the presence of sufficiently long-lived accelerated electrons an effect might be observed which has all the outward symptoms of an anomalous resistivity. Because of their interaction with the oscillations due to the anomalous Doppler effect, the runaway electrons take on a largely isotropic velocity distribution and may make a significant contribution to the plasma pressure. The "temperature" $T_0 = p/n_0$ determined from the pressure p, may then be considerably higher than the temperature T_e of the main electrons. Correspondingly the classical conductivity, calculated from T_0, will then be higher than the true conductivity. Author (NSA)

N68-25455# California Univ., Livermore. Lawrence Radiation Lab.
ALICE EXPERIMENT
C. C. Damm, J. H. Foote, and A. H. Futch, Jr. 23 Jan. 1968 22 p refs Presented at Intern. Conf. on Plasma Confined in Open Ended Geometry, Gatlinburg, Tenn., 1-3 Nov. 1967
(Contract W-7405-eng-48)
(UCRL-70655; CONF-661127-3) CFSTI: HC $3.00/MF $0.65

The Alice neutral-injection experiment employs a quadrupole magnetic-well containment field, formed by a coil in the shape of a baseball seam. Plasma densities as high as $5 \times 10^8/cm^3$ have been measured corresponding to a ratio of $(\omega_{pi}/\omega_{ci})^2 \approx 0.36$, where ω_{pi} and ω_{ci} are the ion plasma frequency and gyrofrequency respectively. Intermittent plasma oscillations have been observed at densities above $10^8/cm^3$ both at ω_{ci} and at higher frequencies. These oscillations are accompanied by anomalous loss of particles. Bursts of electrons and possibly energetic protons have been detected emerging through the mirror regions. In the presence of these losses the plasma density is limited to a value below that determined by charge exchange. At the highest density reached, the anomalous losses and charge-exchange losses are comparable. Introduction of a small energy spread into the otherwise monoenergetic, 15-keV injected beam was observed to increase the threshold density for onset of the plasma oscillations. In an effort to affect the instability mode or modes observed, and to obtain specific mode identification with theory, experiments designed to further broaden the energy distribution of the trapped protons and other experiments aimed at heating the plasma electrons with microwave radiation are underway. Author (NSA)

N68-25489# Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica.
ON THE THEORY OF THE DIOCOTRON INSTABILITY: A SERIES DEVELOPMENT METHOD
W. Schuurman Aug. 1967 13 p refs
(NP-17362; Rept.-67-41)

The long wavelength diocotron instability is analyzed theoretically in rectangular geometry by means of a series expansion in $\epsilon = \omega_p^2/\omega_C^2$. Within the convergence region results of existing theories for either $\epsilon << 1$ or $\epsilon \approx 1$ are found back. The mathematical tools are not complex, so that it may be expected that new effects, e.g., a magnetic field gradient, a non-zero temperature, can be built into the theory. Author (NSA)

N68-25551*# Michigan Univ., Ann Arbor. Electron Physics Lab.
FREQUENCY MULTIPLICATION IN HIGH-ENERGY ELECTRON BEAMS Semiannual Progress Report, 1 Oct. 1967-31 Mar. 1968
W. D. Getty, G. I. Haddad, R. J. Lomax, and J. E. Rowe Apr. 1968 20 p refs
(Grant NGR-23-005-183)
(NASA-CR-94680; SAPR-3) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The possibility of building a beam plasma system which operates at a uniform pressure is investigated, and a study to determine the effect of collisions on the instability of a beam-plasma system is described. A time-dependent nonlinear analysis of electron-beam plasma interaction is discussed along with an effort to develop a model which uses the dielectric constant to describe the nonlinear effect in the plasma. The instabilities in a magnetized plasma with an anisotropic velocity distribution was studied with objective being to examine the feasibility of using this instability for electron cyclotron harmonic generation. Several methods of analyzing the nonlinear beam plasma and the two stream interaction system using digital computer simulation techniques are also reported. Studies on the use of paramagnetic and semiductor materials to detect millimeter and submillimeter waves are included. B.S.D.

N68-25608*# Volt Technical Corp., Washington, D. C.
ON THE NATURE OF THE INHOMOGENOUS STRUCTURE OF INTERPLANETARY PLASMA [O PRIRODE NEODNORODNOY STRKTURY MEZHPLANETNÓY PLAZMY]
N. A. Lotova and A. A. Rukhadze Greenbelt, Md. NASA Goddard Space Flight Center 20 May 1968 8 p refs Transl. into ENGLISH from Astron. Fiz. (USSR), v. 45, no. 2, 1968 p 343-347
(Contract NAS5-12487)
(NASA-CR-94795; ST-IS-PP-10715) CFSTI: HC $3.00/MF $0.65 CSCL 20I

One of the possible mechanisms is discussed of inhomogenous structure formation in interplanetary plasma. This mechanism is based on plasma instability on account of temperature anisotropy in interplanetary plasma. Various types of instabilities are considered with their spectra as a function of the value of parameter β applicably to different regions of interplanetary plasma. It is pointed out that smaller inhomogeneities, of $\approx$ 20 to 100 km exist side by side with the observed ones with characteristic dimensions of $\approx$ 300 to 600 km, namely in remote regions from the sun, exceeding 1 a.u. Attention is drawn to the appropriateness and advisability of such small-scale inhomogeneities' observations. Author

N68-25630*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF ARRIVAL RATES OF ABSORBATE IONS AND ATOMS ON SURFACE COVERAGE, HENCE WORK FUNCTIONS, OF EMITTING ELECTRODES
James F. Morris Washington Jun. 1968 10 p refs
(NASA-TN-D-4369) CFSTI: HC $3.00/MF $0.65 CSCL 20I

This report gives equations for determining substrate surface coverages from arrival rates and desorption characteristics of adsorbate ions and atoms. With a correlating theory by Gyftopoulos and Steiner, these coverages yield estimates of work functions for emitting electrodes with partial monolayers of other metals on their surface. Author

N68-25653# California Univ., Livermore. Lawrence Radiation Lab.
NEUTRAL INJECTION IN THE SUPERCONDUCTING LEVITRON
E. J. Lauer 28 Feb. 1968 8 p
(Contract W-7405-ENG-48)
(UCID-15295) CFSTI: HC $3.00/MF $0.65

Neutral injection making use of the gas ionization products as a target plasma has been reexamined. The main processes considered are ionization of gas (of density n_0) by electrons to form H_2 ions which are quickly dissociated to form cold H+ ions (density n_c), loss of n_c due to anomalous diffusion with a mean containment time τ_c, trapping of hot protons (density n_h) by charge exchange with n_c and by ionizing collisions with n_h and loss of n_h by charge exchange with n_0 and by anomalous diffusion with a mean time τ_h. The density of electrons is set equal to the density of positive ions. A steady state function exists for τ_c vs n_0 (with constant τ_h/τ_c) independent of n_h and n_c. The maximum value of the steady state τ_{c0} varies inversely as IL/V where I is the current of energetic H^0, L is the beam path length through the plasma and V is the plasma volume. If τ_c in an experiment is greater than the maximum value of τ_c on the above steady-state curve, then burnout proceeds until there is exponentiation of n_h independent of n_c; if τ_c is less than the maximum value on the steady state curve, then n_e decreases to the steady state value. In this case n_h and n_c are proportional to I_0 the number of the new H_2 molecules per second entering the plasma. Author (NSA)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N68-24347# Northwestern Univ., Evanston, Ill. Dept. of Materials Science.
ELECTRONIC DRIFT MOBILITIES AND SPACE CHARGE LIMITED CURRENTS IN LITHIUM-DOPED ZINC OXIDE
M. A. Seitz and D. H. Whitmore Mar. 1968 40 p refs
(Contract Nonr-1228(16))
(AD-667469)

Electron drift mobilities and lifetimes were measured from 250 to 400K in oriented single crystals of high-resistivity, Li-doped ZnO by determining the transit time across a plane-parallel specimen for electrons which had been photoinjected at one surface by light pulses of about 10 nsec duration. Drift mobilities at 300K ranged from 2 - 8 sq cm/V/sec for the specimens investigated with no orientational dependence being apparent. The observed exponential temperature dependence of the mobility indicated that the electron drift mobility is primarily controlled by thermal release from trapping states, of estimated density 10 to the 16th power/cu cm, lying in a 0.29-eV region below the conduction band. Electron lifetimes, estimated from low-field data, showed some orientation dependence and ranged from 30 - 100 microsec at room temperature, while electron ranges were 0.0001 to 0.001/sq cm/V and were temperature independent. Ohmic electrodes of indium were used to inject electrons into plane-parallel monocrystals of Li-doped ZnO, producing space-charge-limited currents at high fields. The observed current-voltage and current-temperature relations indicated that discrete or narrow bands of electron traps existed in the 0.4-eV and in the 0.72 to 0.80-eV regions below the conduction band edge with densities of 0.004 and 10 to the 17th power/cu cm, respectively. Author (TAB)

N68-24348# Pennsylvania Univ., Philadelphia.
OPTICAL LATTICE MODES OF MIXED POLAR CRYSTALS
G. Lucovsky (Xerox Corp., Rochester, N. Y.), M. Brodsky (Night Vision Lab., Ft. Belvoir, Va.), and E. Burstein Mar. 1968 11 p refs
(Contract Nonr-551(51))
(TR-19; AD-667609)

An analysis of the available infrared and Raman spectra for mixed crystals suggests that two mode behavior occurs in situations where localized modes and gap modes are possible in the end members. If neither gap nor localized modes are possible, then one mode behavior results. Furthermore one mode behavior generally occurs when there is frequency overlap between the restrahlen bands of the end members. However, the lack of frequency overlap is not necessarily associated with two mode behavior. Author (TAB)

N68-24349# Naval Weapons Center Corona Labs., Calif.
SEMICONDUCTING THIN FILMS: AN ANNOTATED BIBLIOGRAPHY, 1967 SUPPLEMENT
W. R. Turnbull 1 Mar. 1968 157 p refs
(NOLC-745; AD-667233)

The 1967 supplement to NOLC Report 712, Semiconducting Thin Films, An Annotated Bibliography (1956-1966) (AD-655 100) continues the comprehensive bibliographic survey on the preparation, properties, applications, and theory of semiconducting thin films. It is comprised of 485 references, the majority of which were published in 1967, from English and foreign language periodical literature. The abstracts are arranged by author under the following classes: (1) Elemental, (2) Group III-V, (3) Group II-VI, (4) Group IV-VI, (5) Group IV-IV, and (6) miscellaneous compounds. All of the materials are indexed with the exception of the miscellaneous compounds (Groups I-V, I-VI, and I-VII). Author (TAB)

N68-24362# Illinois Univ., Urbana. Dept. of Physics.
HIGH-PRESSURE MOESSBAUER STUDIES ON IRON AND ITS DILUTE ALLOYS
Joseph Andrew Moyzis, Jr. Feb. 1968 161 p refs
(Contract AT(11-1)-1198)
(COO-1198-512) CFSTI: HC $3.00/MF $0.65

The Moessbauer effect has been used to study the effect of very high pressure on dilute alloys of ^{57}Fe in iron, copper,

vanadium, and titanium at room temperature. The pressure dependence of the Moessbauer f number for ^{57}Fe in copper, vanadium, and titanium was studied. Values of the Debye parameter θ and the second inverse moment of the lattice spectrum for the host metals are obtained. The pressure dependence of the Moessbauer isomer shift for ^{57}Fe in iron, copper, vanadium, and titanium was studied. An analysis of the iron data gives a relation between the isomer shift parameter and the redistribution, with volume, of the iron conduction electrons between the 4s and 3d bands. Similar analyses are made for copper, vanadium, and titanium. Author (NSA)

N68-24503# General Electric Co., Philadelphia, Pa. Missile and Space Div.

NUCLEAR MAGNETIC RESONANCE: THEORY AND APPLICATION

John C. Smith and J. R. Ahlstrom 26 Jul. 1967 32 p refs
(TIS-67SD227A)

A detailed discussion of the theory of nuclear magnetic resonance is presented. A brief account of the uses of the two types of NMR spectrometers is given, and a detailed discussion of a wide-line spectrometer is included. Author

N68-24510*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

IONIC CONDUCTIVITY OF SOLID MIXTURES

William L. Fielder Washington May 1968 refs
(NASA-TN-D-4606) CFSTI: HC$3.00/MF$0.65 CSCL 20L

The conductivities of four solid mixtures were determined as a function of temperature: (1) the lithium fluoride–lithium chloride eutectic, (2) the lithium chloride–potassium chloride eutectic, (3) the lithium fluoride–sodium chloride eutectic, and (4) a 50-mole-percent mixture of sodium chloride and potassium chloride. Two conductivity regions were obtained for each of the four mixtures. The activation energies for the conductivity for the lower-temperature regions ranged from 14 to 27 kilocalories per mole (59 to 114 kJ/mole). These energies were similar to the cation migration energies for the single crystals of the alkali halides. The conductivity of the mixtures in the lower-temperature regions is best explained by the following mechanism: (1) formation of cation vacancies primarily by multivalent impurities, and (2) migration of the cations through these vacancies. The activation energies for the conductivity of the solid mixtures in the upper-temperature regions ranged from 5 to 9 kilocalories per mole (20 to 39 kJ/mole). These values are significantly smaller than those energy values that might be expected for a normal intrinsic process. The low activation energies may reflect an ion transport process through a liquid-like state (premelting) or along low-energy paths such as line or plane imperfections. Additional evidence is needed before an upper-temperature region mechanism can be suggested with certainty. Author

N68-24566# General Electric Co., Schenectady, N. Y. Research and Development Center.

CHANGE IN FIELD INTENSIFICATION FACTOR β OF AN ELECTRODE PROJECTION (WHISKER) AT SHORT GAP LENGTHS

H. C. Miller May 1967 13 p refs
(Rept.-67-C-172)

The electrode projection was approximated by a grounded plane and a separate grounded sphere, the opposing electrode by a charged plane. β was found as a function of gap length, projection height, and projection tip radius. The results may be used to find the height (and tip radius) of a projection in a small gap by measuring β as a function of gap length. Author

N68-24594# Los Alamos Scientific Lab., N. Mex.

SPECIAL CRYSTALLOGRAPHIC RELATIONSHIPS OF LATTICE GROUPS

P. Niggli Jan. 1968 11 p Transl. into ENGLISH from the Book "Handbuch Der Experimentalphysik", Vol. 7, Pt. 1, Chapter 4, Sect. 1, Leipzig, Akad. Verlagsges., 1928 p 108–116
(LA-TR-68-5) CFSTI: HC$3.00/MF$0.65

In order to prove the equivalence of two quadratic forms (two space lattices), each quadratic form must be reduced. If they are equivalent to one another, they must give the same reduced form. The reduction of the specific positive ternary quadratic forms corresponds to the representation of a space lattice by a distinguished, easily found primitive triplet. General rules are given for the reduction process. Conditions by which the reduced form may be recognized are listed. NSA

N68-24660*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

HIGH ENERGY PROTON DAMAGE IN SILICON SURFACE BARRIER DETECTORS

Jag J. Singh and Emanuel Rind Washington May 1968 33 p refs
(NASA-TN-D-4528) CFSTI: HC$3.00/MF$0.65 CSCL 20L

The performance of a number of silicon surface barrier detectors has been studied under bombardment with 5.0-MeV, 20.0-MeV, and 40.0-MeV protons. The detectors investigated fall under three categories: (1) normal 100 microns deep; (2) normal 500 microns deep; and (3) fully depleted (dE/dx) type, 500 microns deep. Measurements made include rate of deterioration of charge collection efficiency, variation of resolving power, variation of leakage current, variation of noise level, and changes in detector capacitance as a function of the incident proton dose. From these several data, formulas giving relationships between the proton dose and the degree of detector resolving power deterioration have been developed for the normal and fully depleted type of detectors. Measurements clearly establish that: (1) the fully depleted detectors are more radiation damage resistant than the normal detectors; (2) the increased collecting field across the sensitive region reduces the damage sensitivity; and (3) the damage threshold of detectors made from lower resistivity materials is higher than that of those made from higher resistivity materials. In the case of dE/dx detectors, there was no convincing evidence of any difference in degradation rates when viewed from the positive or negative sides of the detectors. Author

N68-24673# Nebraska Univ., Lincoln.

STUDIES OF IMPERFECTIONS IN SOLIDS Progress Report

Feb. 1968 33 p refs
(Contract AT(11-1)-525)
(COO-525-30) CFSTI: HC$3.00/MF$0.65

Design of a calorimeter to be used for measurements of stored energy in alkali metal halide crystals in the temperature range −190 to 400°C is described. Data on the intensity of x-rays scattered from Pb are included. The data are investigated for the presence of Kohn anomalies due to electron–phonon interactions. Plans for the investigation of the dynamical properties of other crystals using x-ray thermal diffuse scattering are discussed briefly. A Phillips x-ray diffractometer being prepared for measurements of elastic constants of chromium and Debye–Waller factors of cesium halides is described. Some data are given on scattering of x-rays by Cr. NSA

N68-24676# IIT Research Inst., Chicago, Ill. Dept. of Physics.

THERMAL MEASUREMENTS ON SOLIDS BELOW 1°K Progress Report

Harold Weinstock Jan. 1968 25 p refs
(Contract AT(11-1)-1629)
(COO-1629-3; PR-2) CFSTI: HC$3.00/MF$0.65

Measurements of thermal conductivity in the range 0.4 to 4.0°K were carried out on initially high-purity KCl single crystals subjected to various radiation and temperature treatments. The results indicate a resonant-type decrease in conductivity below 1°K in specimens given high doses ($\approx 10^8$ to 10^9 R) of gamma radiation at room temperature and possessing correspondingly high ($\approx 10^{18}/cm^3$) F-center concentrations. This behavior is interpreted in terms of a geometrical scattering resonance. A crystal irradiated at liquid-nitrogen temperature and measured immediately showed a relatively low conductivity, which increased considerably after cycling to room temperature. This suggests a recombination or annealing of lattice defects between 77 and 300°K. A cryostat designed to measure thermal conductivity in a high magnetic field down to 0.3°K and a facility for growing single crystals large enough and perfect enough for thermal conductivity measurements are described. NSA

N68-24677# Kansas Univ., Lawrence. Dept. of Physics.
INTERACTIONS BETWEEN PARAMETRICALLY EXCITED SPIN WAVES IN YTTRIUM IRON GARNET
John D. Bierlein 1968 140 p refs
(Contract AT(11-1)-1488)
(COO-1488-9) CFSTI: HC $3.00/MF $0.65

Accurate measurements were made that show the steady-state and transient dependence of both $M_z(2\omega)$ and the uniform mode on applied microwave field for fields above and below Suhl threshold. These data are then compared with a theory developed here which shows that many interesting effects can be explained in terms of the parametric nature of higher-order spin wave interactions. This investigation has provided a study of parametric interactions among spin waves, the fundamental excitations in magnetic insulators. The normal mode theory of ferrimagnetic resonance following closely the approach of Suhl and Schlömann. The present theory is applicable only for narrow line-width samples. The effects of higher order interactions among spin waves excited by the Suhl processes are considered. Relations for the second harmonic contribution to the z-component of magnetization are derived for cases where zero, one, and two spin wave pairs are excited. A simple vector model is presented from which the general characteristics of both the steady-state and transient response of $M_z(2\omega)$ readily can be determined. An approximate many spin wave approach is derived which gives much better quantitative agreement than the relatively simple two-spin-wave-pair model. The general characteristics of the observed second harmonic line profile can also be reproduced using this method. NSA

N68-24678# IIT Research Inst., Chicago, Ill. Dept. of Physics.
INVESTIGATION OF ENERGY TRANSFER PROCESSES BY FLASH PHOTOLYSIS (RADIATION EFFECTS IN SOLIDS) Progress Report, Feb. 1967–Feb. 1968
Leonard I. Grossweiner Feb. 1968 17 p refs
(Contract AT(11-1)-1052)
(COO-1052-9; PR-10) CFSTI: HC $3.00/MF $0.65

Recent measurements of KCl fracture surface energy by the slow-cleavage technique show that ^{60}Co irradiation induces a fracture energy increase proportional to the dose. Experiments with additively colored KCl show that the major changes are not caused by the F centers. The absorption spectrum of the R-center quartet state in γ-irradiated NaCl was resolved by dichroic low-temperature bleaching measurements. The resulting energy diagram is similar to that deduced for the R center in KCl based on the stress-induced splitting of the spectra. Similar results were obtained on γ-irradiated KI. The mechanism of optical conversion of F centers to M and R centers in KCl was investigated by the repetitive light-pulse method. The initial conversion rates increase with increasing pulsing period and are independent of the initial F-center concentration. The data are in good agreement with a kinetic model F centers coalesce with nearby negative ion vacancies to form the M centers. The formation of R centers competes with the growth of M centers in the early stages. A refined apparatus was used to continue work on dye sensitization of zinc oxide photoconductivity. The new work supports the proposed theory in which the transfer of electrons from zinc oxide to the dye film establishes a Schottky barrier in the dark. Results with eosin indicate that the mechanism applies for dye films varying from monolayers to at least 10 layers thick. NSA

N68-24731*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EFFECTS OF A HIGH-ENERGY PARTICLE ENVIRONMENT ON THE QUANTUM EFFICIENCY OF SPECTRALLY SELECTIVE PHOTOCATHODES FOR THE MIDDLE AND VACUUM ULTRAVIOLET
Donald F. Heath and James H. Mc Elaney (Fairfield Univ.) May 1968 15 p refs
(NASA-TM-X-63215; X-622-68-180) CFSTI: HC $3.00/MF $0.65
CSCL 20L

The quantum efficiencies of spectrally selective photocathodes for the middle and vacuum ultraviolet were measured. The photocathode materials which were investigated are semitransparent depositions of CsI, CuI, and CsTe on Al_2O_3 windows, and a solid tungsten photocathode located behind a MgF_2 window. The quantum efficiencies of these photocathodes were measured before their use as detectors in an Aerobee 150 rocket experiment, and again one year later. There was no observable change in their quantum efficiencies in this interval. These photodiodes were then irradiated with a dose of 5×10^{13} electrons/cm^2 at 1.0 MeV, and 5×10^{13} electrons/cm^2 at 2.0 MeV. This electron energy and dose represent what might be encountered in the artificial radiation belt in a circular, near polar orbit at 1400 km in the course of a year. The quantum efficiencies of the photodiodes were again measured. Only the CsI photodiode showed a change, an increase by almost two and one-half times in its quantum efficiency. Author

N68-24928 Washington State Univ., Pullman.
THE KINETICS OF PHASE CHANGE IN SOLIDS BY SHOCK WAVE COMPRESSION
Yasuyuki Horie (Ph.D. Thesis) 1966 154 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-1560

Shock wave propagation in solids which undergo solid-solid phase changes is considered in a hydrodynamic approximation, i.e., the rigidity of materials is neglected and the thermodynamical states are assumed to be functions only of pressure and temperature. The kinetics of transition are suggested by principles of irreversible thermodynamics. To study the development of a shock wave in time, integration of the flow equations is accomplished by a staggered difference method using a linear artificial viscosity. Numerical studies of the decay of the precursor are made with three relaxation times, .1, 1/3, and 1 μsec. The calculation does not show a pressure drop behind the precursor, though such a drop has been reported to have been observed experimentally. No systematic experiments exist to support the major decay of the first shock. The Hugoniot and pressure-particle velocity relations are compared with experimental data. There is qualitative agreement. Dissert. Abstr.

N68-24976# General Electric Co., Schenectady, N. Y. Research and Development Center.
METALLIC INTERFACES, 2: INFLUENCE OF THE EXCHANGE-CORRELATION AND LATTICE POTENTIALS
A. J. Bennett and C. B. Duke May 1967 41 p refs
(Rept.-67-C-209)

An electron gas model of a metallic interface is constructed by joining two semi infinite half planes of unequal positive charge

and adding electrons until a charge neutral system is achieved. The exchange and correlation effective one-electron potential, formerly taken in the dipole-approximation to equal its bulk value in each material, is calculated using the local density approximation. A modified self-consistent free electron model of a metal intrinsic semiconductor junction adequately accounts for several features of the experimental data on the dependence of the barrier height on the components and method of fabrication of the junction. A primary effect of energy gaps introduced by the periodic potential is the introduction of a long range contribution to the junction potential in the semiconductor. The modified free electron model adequately determines the barrier height at the interface although it never describes the details of the space charge potential in the semiconductor. Author

N68-24995*# Rensselaer Polytechnic Inst., Troy, N. Y. Interdisciplinary Materials Research Center.
NMR STUDIES OF DOMAIN SWITCHING IN FERROELECTRIC ROCHELLE SALT
T. Oja and P. A. Casabella [1968] 11 p refs Sponsored in part by AEC
(Grant NsG-100)
(NASA-CR-94755) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The Na^{23} NMR satellite line spectrum in the ferroelectric phase of Rochelle Salt is used to obtain hysteresis loops and to investigate the relation between the rate of polarization reversal and the change of externally applied electric field. Author

N68-25004 Pennsylvania Univ., Philadelphia.
THE JOSEPHSON AC EFFECT IN TUNNEL JUNCTIONS
Robert Edwin Eck (Ph.D. Thesis) 1966 152 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-3065

Structure observed in the dc current–voltage (I–V) curves of tunnel junctions due to the interaction between the Josephson ac current and the electromagnetic field in the junction has been investigated. The structure appears as a resonant shaped peak or vertical current steps. The position of the peak depends approximately linearly on an applied magnetic field while the current steps occur at fixed positions, the particular steps observed depending on the magnetic field. The Josephson current enters the wave equation describing the electromagnetic field as a driving current. The ac voltage developed across a junction modifies the frequency of the Josephson ac current such that it has an ac component. The resonant peak occurs when both the spatial and time variation of the field are determined by the Josephson current. The steps are observed when the spatial variation of the field is restricted by boundary conditions imposed by the edges of the junction. Dissert. Abstr.

N68-25005 Maryland Univ., College Park.
INTRINSIC EFFICIENCIES AND RADIATION DAMAGE IN POLYCRYSTALLINE PHOSPHORS IRRADIATED WITH HIGH ENERGY ELECTRONS
Ralph Leon Belcher (Ph.D. Thesis) 1966 138 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-2361

The intrinsic efficiencies for the conversion of electron beam power into radiant power by powdered CdS:Ag and ZnS:Cu phosphors were measured. The phosphors were excited with monoenergetic electrons and the irradiance on a fast thermopile with a uniform spectral response was determined. Using Berger's calculation for the deposition of energy as a function of depth in target, the Kubelka–Munk equation for the transmission of light from various layers of the phosphor, and measured values for the reflectance of an infinite thickness of phosphor for its own light, a computer program was devised to calculate the efficiencies. Approximate values of the scattering and absorption coefficients were calculated from measurements of the reflectance. The decrease in radiant emittance of the CdS:Ag phosphor was determined as a function of the total energy absorbed by the phosphor. A method was developed for the precise measurement of the kinetic energy of an intense monoenergetic beam of electrons. Dissert. Abstr.

N68-25039 Tennessee Univ., Knoxville.
A MOSSBAUER EFFECT ISOMER SHIFT STUDY OF ^{57}FE DISSOLVED IN 3-D TRANSITION METAL ALLOYS
William Newton Cathey (Ph.D. Thesis) 1966 82 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-1356

The Mossbauer effect isomer shift, which measures the relative s electron density at a nucleus, was used to examine the electronic structure of Fe impurity atoms dissolved in 3d transition metal alloys. A constant acceleration electromechanical drive system was used in conjunction with a multichannel analyzer to collect data for ^{57}Fe of less than 0.1 per cent concentration (except where Fe was a major alloy constituent) in $Ti_{23}V_{25}$. TiV, V, CrV, Cr, $Cr_{75}Fe_{25}$, FeCr, $Fe_{75}Cr_{25}$, Fe, FeCo, $Co_{70}Fe_{30}$, $Co_{88}Fe_{12}$, Co, CoNi, Ni, CuNi, Cu, and $Cu_{70}Zn_{30}$. The data were analyzed by using a model in which the impurity atom was screened by the s-type conduction electrons of the host alloys. The isomer shift versus charge density curves of Walker, Wertheim, and Jaccarino were used as a calibration. Dissert. Abstr.

N68-25046 Ohio Univ., Athens.
THE TRANSPORT PROPERTIES OF PALLADIUM-GOLD ALLOYS
Nguyen Hy Hau (Ph.D. Thesis) 1966 117 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-1222

Measurements of the absolute thermoelectric power (TEP) and the electrical resistivity of polycrystalline palladium and gold, as well as a number of Pd–Au alloys over the composition range, have been made in the temperature range from 4.2 to 375°K. These alloys were prepared by inducting melting, chill casting, and homogenizing for a long period. X-ray analyses of the samples show that they form a continuous series of f.c.c. solid solutions, with no evidence of long-range order, and present a large change in the lattice parameter. A small negative deviation from Vegard's law was observed, with a maximum in the deviation coinciding with a change in the electronic structure, presumably the filling of the d band. The overall pattern of the TEP results is normal and similar in character to that found in alloys of normal metals which do not contain a transition metal. The absolute TEPs of all the alloys are negative in the temperature range studied. Dissert. Abstr.

N68-25085 Cincinnati Univ., Ohio.
LOCALIZED MAGNETIC STATES IN DILUTE METALLIC ALLOYS
John William Schweitzer (Ph.D. Thesis) 1966 103 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-1994

The extra orbital model of Anderson is assumed to provide a qualitative description of the electronic properties of systems composed of simple metals with very dilute concentrations of dissolved impurity atoms of the transition elements. Approximate solutions are obtained for both the case of a nondegenerate and the case of a degenerate extra orbital state using a Green's function technique which attempts to treat the correlation effects that are neglected in a Hartree–Fock approximation. An approximation to the exact one-electron Green's function is obtained by decoupling the hierarchy of coupled equations which relate the Green's functions of higher orders. Using this approximate Green's function the change in the total density of states due to the impurity is investigated and compared with Anderson's result which is on a Hartree–Fock

approximation. The temperature dependence of the magnetic susceptibility and of the specific heat are also determined. Dissert. Abstr.

N68-25089 Maryland Univ., College Park.
THE PHONON SPECTRUM OF A SHOCKED SOLID
Paul Harris (Ph.D. Thesis) 1966 87 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-2332

The Boltzmann equation for the phonon distribution function is derived for a medium undergoing large strains in the hydrodynamic approximation (driving frequency less than the collision frequency). The phase space in which the Boltzmann equation holds is found to be different from that phase space composed of ordinary position and "crystal momentum" spaces common to the linear theory. A transformation, involving the volume dependence of the sound speed, is shown to relate the two different spaces. Existing linear theory is reexamined with the idea of developing a firm understanding of the physics of amplitude independent phonon-phonon sound absorption in insulators. Finite strain theory is used to develop a Hamiltonian for a single phonon in the presence of large amplitude deformations. Using the Hamiltonian and the collision term, the Boltzmann equation is solved in the long wave length approximation with temperature and strain as independent variables. Thermoelastic equations are developed, and the Burgers equation is investigated with the hope of finding simultaneous solutions for the strain and temperature (as functions of position and time) for substituting into our solution of the microscopic physics Boltzmann equation. Dissert. Abstr.

N68-25113 Texas Univ., Austin.
CALCULATION OF ULTRASONIC ATTENUATION IN COPPER FROM AN EMPIRICAL ENERGY SURFACE
David Boyd Doan (Ph.D. Thesis) 1966 92 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-3275

Using the semi-classical, Boltzmann approach, the theory of ultrasonic attenuation in metals in a magnetic field is generalized to include real metal effects. In the case of a metal with a badly warped Fermi surface, such as copper, the correction terms have a considerable effect on the shape of the attenuation versus magnetic field curves. The correction terms have the same periodicity in $1/B_0$, where B_0 is the magnetic field, as the conductivity tensor term of Cohen, Harrison, and Harrison. It is also found that the correction terms have no effect on the attenuation if the effective mass and the deformation potential are constant over the Fermi surface. Calculations of the attenuation have been made for several orientations of the magnetic field using Roaf's empirical expression for the Fermi surface of copper. The need for correcting the free electron theory is particularly evident in the calculated results for the case in which the magnetic field is oriented in such a way that open orbits are present. Dissert. Abstr.

N68-25115 Tennessee Univ., Knoxville.
ULTRASONIC MEASUREMENT OF THE NON-LINEARITY PARAMETERS OF COPPER SINGLE CRYSTALS
Wilhelm Belrupt Gauster (Ph.D. Thesis) 1966 106 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-1363

The nonlinearity parameters of neutron irradiated copper single crystals were determined by measuring quantitatively the harmonic distortion of pulsed MHz ultrasonic waves propagating in three crystallographic directions. For this purpose a capacitive detector was developed with which it is possible to detect and measure absolutely ultrasonic displacement amplitudes of the order of 10^{-10} cm. As verification of the technique, measurements on a single crystal of germanium were made. The results are in good agreement with those obtained for the same sample by another technique. The results of the copper experiments are combined with three published sets of values of the pressure derivatives of the second order elastic constants to calculate three sets of the six third order elastic constants. The problem of error propagation in this calculation is discussed. Dissert. Abstr.

N68-25124 Arizona State Univ., Tempe.
ELECTRICAL CONDUCTION AND DEFECTS IN KH_2PO_4 AND KD_2PO_4
Charles Thomas Perrino (Ph.D. Thesis) 1967 94 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-3208

The conductivities of the following systems have been investigated: (1) KH_2PO_4-$KHSO_4$, and (2) KD_2PO_4-$KDSO_4$. Very little difference was noted between the conductivity of KH_2PO_4 and KD_2PO_4. One exception was the lowering of the temperature at which the formation of ions becomes an important factor in conduction. Infrared and neutron inelastic scattering results of other authors are used to explain this difference. A possible mechanism for conduction is proposed considering the sequence of intrabond and interbond jumps and the crystal structure. Dissert. Abstr.

N68-25149 Iowa State Univ. of Science and Technology, Ames.
THE FERMI SURFACE OF TUNGSTEN
Robert Franz Girvan (Ph.D. Thesis) 1966 245 p
Available from Univ. Microfilms: HC $11.05/MF $3.20 Order No. 67-2045

Impulsive-field de Haas-van Alphen effect measurements have been carried out to study the Fermi surface of tungsten. An empirical model was constructed by fitting an equation for the shape of the Fermi surface to the results of this experiment combined with the Gantmakher size effect results of other investigators and with theoretical predictions for the Fermi surface shape. Good overall agreement is obtained between the predictions of the empirical model and experiment showing that a surface with the general features of the Lomer model can account for all of the experimental results. However, the empirical model is imprecise in certain respects, and small changes are indicated for a more precise description of the Fermi surface. Dissert. Abstr.

N68-25151 Pennsylvania State Univ., University Park.
MOESSBAUER INVESTIGATION OF NUCLEAR ELECTRIC QUADRUPOLE INTERACTIONS AND MAGNETIC PROPERTIES OF SOME CRYSTALLINE IRON COMPLEXES
David Julius Simkin (Ph.D. Thesis) 1966 147 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-1955

The Moessbauer Effect is applied to three different problems. The sign of the electric gradient at the iron nucleus is measured in a ferrocene single crystal. Quadrupole interactions are studied in the $Fe_{1-x}O$-MgO system. The spin-flop temperature of an $\alpha 2Fe_2O_3$ single crystal is measured in external magnetic fields up to 10,000 gauss, applied in the basal plane. The angular dependence of the relative spectral line intensities of the single crystal Moessbauer spectrum is used to determine the sign of V_{zz}, the electric field gradient at the iron nucleus, in a ferrocene single crystal. The sign is found to be negative, in agreement with the results of a ligand field theory calculation, and contrary to the results of a molecular orbital calculation. The experimentally determined spin thus spports an ionic module, as opposed to a covalent model, for ferrocene. Quadrupole interactions are observed in the Moessbauer spectra of $Fe_{1-x}O$-MgO crystals with Fe^{2+} concentrations above 18.34%. Dissert. Abstr.

N68-25179 Ohio State Univ., Columbus.
EXCESS CHARGE CARRIER LIFETIME DEGRADATION IN SILICON AS CAUSED BY MONOENERGETIC NEUTRON IRRADIATION

Robert Ray F. Speers (Ph.D. Thesis) 1966 95 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-2543

Silicon p–i–n diodes were irradiated with monoenergetic neutrons having energies from 0.36 to 4.77 MeV. The variation with neutron energy of the damage coefficient for diode storage time, $\alpha_T = \Delta(1/T_s)/\Phi$, and diode forward voltage sensitivity at constant current, $S = \Delta V_f/\Phi$, were determined and found to be equal. Since α_T and S are linearly related to the damage coefficient for high level lifetime, $\alpha_\tau = \Delta(1/\tau)\Phi$, the variation with neutron energy of α_τ was also established. Theoretically, α_τ is proportional to N_r, the number of active recombination centers added per cm^3 per incident neutron per cm^2. It was hypothesized that N_r is proportional to $E(E_n)$, the average energy given to lattice atoms per cm^3 per incident neutron per cm^2. The theory of Lindhard, Nielson, Scharff and Thomsen was used to calculate $\bar{E}(E_n)$. A graphical comparison showed that $\alpha_T S$ and $\bar{E}(E_n)$ have the same neutron energy dependence, $E_n^{0.5}$. Dissert. Abstr.

N68-25238 California Inst. of Tech., Pasadena.
DISLOCATION MOBILITY IN PURE COPPER SINGLE CRYSTALS
William Franklin Greenman (Ph.D. Thesis) 1967 123 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-433

This thesis presents the results of an experimental investigation of the stress dependence of dislocation velocity in 99.999 per cent copper single crystals. Dislocation displacements were detected by etch pitting dislocation sites on {100} planes. Stress pulses of microsecond duration were applied to single crystal test specimens by means of a torsion impulse machine. Maximum applied, resolved shear stresses ranged from 29 g/mm^2 to 236 g/mm^2, and calculated dislocation velocities ranged from 160 cm/sec to 710 cm/sec. The dislocations were presumably predominantly edge-oriented. The growth of copper single crystals, the spark and chemical machining of single crystal test specimens, and the behavior of the etchants which reveal dislocation sites on {100} planes are also discussed. Dissert. Abstr.

N68-25239 Ohio State Univ., Columbus.
DIFFUSION-INDUCED DEFECT INTERACTION IN THE GOLD-SILVER SYSTEM
Ying-Hsin Liu (Ph.D. Thesis) 1966 157 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-2479

The technique of transmission electron microscopy has been used to study various types of defects generated in the gold-rich side of Au–Ag, platelet-type diffusion couples. The diffusion anneal was conducted under a flowing argon atmosphere at 880°C for one hour; couples were furnace cooled, air cooled, and quenched from the annealing temperature. Both chemical etching and electropolishing techniques were applied to prepare thin foils from the gold-rich side of the couple. The results have shown that the formation of low angle tilt boundaries through dislocation climb and glide is an important process occurring in the diffusion zone. An increase in the dislocation density and the formation of helical and curved dislocations also result from the unbalanced diffusion currents. In addition, new observations on dislocation loops, double cross slip, and hexagonal dislocation networks in pure gold and diffused gold were made. Dissert. Abstr.

N68-25240 Maryland Univ., College Park.
THE EFFECT OF ANNEALING ON THE FIELD EFFECT IN GOLD AND OTHER METALS
Walter Edgar Daniels, Jr. (Ph.D. Thesis) 1966 100 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-2383

Charging a parallel plate capacitor one of whose plates is a thin (≈100 Å) film provides a way of producing small reversible changes in the number of electrons present in the film. With mica as the dielectric it is possible to add or remove one electron for each 10^4 atoms present. Such a change in the number of electrons leads to changes in the normal conductivity and the superconducting transition temperature. The relative change in the normal conductivity $\Delta\sigma/\sigma$ and in the transition temperature $\Delta T_c/T_c$ are linear in the applied field and of the same order of magnitude as the change in the carrier concentration $\Delta n/n$ where Δn is the number of electrons added or removed and n is the number of atoms in the film. Adsorbing a material such as oxygen on the surface of the film provides a way of removing about one electron for every surface atom. This causes a shift in the transition temperature which is almost a 1000 times larger than the direct charging. Dissert. Abstr.

N68-25241 Arizona State Univ., Tempe.
A STUDY OF THERMOELECTRIC POWER IN CERIUM OXIDE
Kenneth Edward Jesse (Ph.D. Thesis) 1967 82 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-3205

The thermoelectric power of cerium oxide was measured with respect to platinum in three specimens containing respectively 0.030, 0.034, and 0.520 atomic percent calcium, and for the following ranges of oxygen partial pressure and temperature: 1.0 to 10^{-3} atmospheres, 300°C to 1400°C; 10^{-4} to 10^{-6} atmospheres 300°C to 900°C. In addition, the transport numbers of the oxygen ions were measured by means of a galvanic concentration cell over a temperature range of 300°C to 850°C and for the following oxygen partial pressures across the cell: Cerium oxide containing 0.034 atomic percent calcium, 1.0 and 10^{-1} atmospheres, 10^{-3} and 10^{-4} atmospheres and 10^{-5} and 10^{-6} atmospheres. Cerium oxide containing 0.520 atomic percent calcium, 1.0 and 10^{-1} atmospheres. The thermoelectric power was found to have a maximum (p-type) near 500°C falling to a maximum (n-type) near 1150°C. The p-type range of the thermoelectric power exhibited the greatest oxygen partial pressure dependence. Dissert. Abstr.

N68-25242 Missouri Univ., Columbia.
THE LATTICE DYNAMICS OF MASS-DISORDERED ALLOYS
Paul Larry Leath (Ph.D. Thesis) 1966 209 p
Available from Univ. Microfilms: HC $9.45/MF $3.00 Order No. 67-2863

The calculation is presented for a binary mass-disordered alloy frequency spectrum $\rho(\omega)$ and the displacement correlations $\langle u(n\alpha)u(m\beta)\rangle$ which affect the interaction with external radiation. The development is in the framework of a perturbation expansion of the one-phonon Green's function. The general form of the multiple-occupancy polynomials $P_n(c)$, shown by Langer to be necessary in the perturbation expansion of the Green's function of a mass-disordered lattice, is derived and its use is illustrated by the summation to all orders in the concentration of impurities of the self-energy diagrams involving one and two vertices. Perturbation calculations are made where the unperturbed lattice is taken to be one with the atomic mass of the major constituent, the concentration c of the minor constituent assumed small. Numerical results are presented for a linear chain and for a bcc lattice with first and second neighbor central forces. Dissert. Abstr.

N68-25243 Iowa State Univ. of Science and Technology, Ames.
GREEN'S FUNCTION METHOD FOR ANTIFERROMAGNETISM
Keum Hwi Lee (Ph.D. Thesis) 1966 182 p
(Contract W-7405-ENG-82)
(IS-T-99) Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-2083

Cubic antiferromagnets with isotropic, nearest-neighbor, Heisenberg interactions are studied for general spin and temperature by using two-time temperature-dependent Green's functions of the spins and the Callen's decoupling scheme. It is shown that the energy spectrum and the sublattice magnetization as functions of temperature are the solutions of a set of coupled equations. The equations are solved numerically for $S=1/2$ and the results compare very well with the existing theories in both high- and low-temperature limits. The Néel temperature is also calculated for general spin. Compared with other theoretical estimations, the Néel temperature obtained this way is appreciably higher for $S=1/2$, but approaches agreement in the large spin limit. The transverse correlation functions of the spins and the correlation length above the Néel temperature are calculated. Dissert. Abstr.

N68-25256 Pennsylvania State Univ., University Park.
RN INVESTIGATION OF BREAKDOWN BEHAVIOR IN SEMICONDUCTORS
Joseph Stach, Jr. (Ph.D. Thesis) 1966 132 p Available from Univ. Microfilms: HC$6.40/MF$3.00 Order No. 67-1958

The purpose of this investigation was to study breakdown phenomena in metal barrier diodes, in particular, gold-n type gallium arsenide, Au–GaAs diodes. The major consequence of the investigation was the observation of recombination radiation when the diodes were biased in the avalanche region. A calculation was made to determine the optical transition probability for transitions across the band gap at the point where the valence band maximum and conduction band minimum occur for the same value of electron momentum. The spectral distribution of the radiation emitted from avalanching diodes had a peak at the band gap energy 1.30 eV. This compares favorably with the band gap energy determined by absorption measurements on the same material. The study indicates that the radiation observed in avalanching metal barrier, Au–GaAs, diodes is the result of electron hole pair recombination across the band gap of GaAs. Dissert. Abstr.

N68-25269 Catholic Univ. of America, Washington, D. C.
DIAGRAMMATICAL ANALYSIS FOR THE ELECTRON GREEN'S FUNCTION IN IMPURE METALS
John Bernard Jalickee (Ph.D. Thesis) 1966 63 p Available from Univ. Microfilms: HC$3.60/MF$3.00 Order No. 67-1835

The purpose of this investigation was to provide a general method of calculating the Green's function for an electron in a random potential from which the level density may be calculated. The diagrammatical techniques which have proved so powerful in the study of classical fluids were applied to the diagrammatical representation of the perturbation expansion of the Green's function. This provided exact integral equations which may be solved systematically in various degrees of approximation. Dissert. Abstr.

N68-25270 Utah Univ., Salt Lake City.
ELECTRON PARAMAGNETIC RESONANCE INVESTIGATION OF IRRADIATION INDUCED DAMAGE CENTERS IN CALCITE
Ronald Lester Marshall (Ph.D. Thesis) 1967 95 p Available from Univ. Microfilms: HC$4.80/MF$3.00 Order No. 67-3129

Many unreported damage centers have been found in calcite irradiated at room temperature with 2 Mev electrons. Two such centers which have been designated as the P-center and the S-center are investigated at 77°K using electron paramagnetic resonance. Rotation patterns for the S-center show rhombic symmetry about an axis parallel to a line connecting two oxygens in a carbonate group. All lines are split by two similar but inequivalent distortions of the g tensor. The lines of the P-center are also split by a small, nearly isotropic hyperfine interaction from a spin 1/2 nucleus. Principle values for the parameters of the spin-Hamiltonian of each center are found to be $g_{11} = 2.037 \pm .001$, $g_{22} = 2.005 \pm .003$, $g_{33} = 2.006 \pm .003$, and $A/g = 6.0 \pm 5$ gauss for the P-center, and $g_{11} = 2.001 \pm .001$ $g_{22} = 2.010 \pm .003$ and $g_{33} = 2.067 \pm .003$ for the S-center. The principle axis coordinate system for the g tensor associated with each center is also explained. Arguments are given which support the designation of CSO_3^- as the model for the S-center. Possible models for the P-center are considered. The general effect of electron and X-ray irradiation on calcite is also discussed. Dissert. Abstr.

N68-25281# Pennsylvania State Univ., University Park. Materials Research Lab.
THE ROLE OF TRAPPING PROCESSES IN SOLID STATE RADIATION DOSIMETRY Progress Report
Heinz K. Henisch Feb. 1968 33 p ref
(Contract AT(30-1)-3409)
(NYO-3409-4) CFSTI: HC$3.00/MF$0.65

A summary of research on solid state radiation dosimetry is presented. The possibility of utilizing the pyroelectricity of tourmaline for X-ray dosimetry is discussed. The use of neutron-irradiated diamonds for uv dosimetry is described. Current-glow measurements of diamonds, obtained by thermal stimulation after uv exposure, are analyzed. Ultraviolet dosimetry using pyroelectric zinc sulfide is considered. Also, thermoluminescent dosimetry of ultraviolet radiation using bismuth-doped zinc sulfide is examined. NSA

N68-25282*# IIT Research Inst., Chicago, Ill.
CHARACTERIZATION OF CERAMIC MATERIALS FOR MICROELECTRONIC APPLICATIONS
A. J. Montvala 4 Mar. 1968 116 p refs
(Contract NAS1-6919)
(NASA-CR-66605) CFSTI: HC$3.00/MF$0.65 CSCL 20L

A major factor to be considered in the characterization of ceramics is the significant differences between the electronic properties of single crystal and polycrystalline materials, due to the presence of grain boundaries in the latter. The grain boundary phase possesses a defect structure and usually has electrical properties different from those of the bulk phase. Therefore, in the characterization of $BaTiO_3$ ceramics, major emphasis has been placed in correlating the bulk properties with the surface or grain boundary properties, taking into consideration the effects of grain size variation and deviations from stoichiometry. Author

N68-25296 Missouri Univ., Columbia.
PHOTOELECTRIC EMISSION FROM STRONTIUM OXIDE
Harley Dean Rutledge (Ph.D. Thesis) 1966 107 p Available from Univ. Microfilms: HC$5.40/MF$3.00 Order No. 67-2874

In this investigation measurements of total photoelectric yield, retarding yield and kinetic energy distributions were made on cathodes of strontium oxide using retarding potential diodes. A theory for the photoelectric emission from strontium oxide was developed which included both an energy dependent transition probability and a direction factor for escape of electrons from the conduction band. An exciton peak at 5.77 eV in the photoelectric yield spectrum was observed. Two donor levels in strontium oxide were tentatively assigned values of 2.5 and 3.2 eV below the vacuum level. The transition probability was observed to rise rapidly between 3 and 4 eV and to exhibit a small maximum at about 4 eV. A slow distribution of electrons of uncertain origin seems to appear at photon energies greater than 4 eV. Dissert Abstr.

N68-25299 Duke Univ., Durham, N.C.
NUCLEAR MAGNETIC RELAXATION IN SOLID HELIUM THREE
Robert Coleman Richardson (Ph.D. Thesis) 1966 141 p Available from Univ. Microfilms: HC$8.80/MF$3.00 Order No. 67-3024

The nuclear relaxation times T_1 and T_2 have been measured in very pure solid He 3 between 0.35°K and 2.0°K as a function of frequency between 0.3 Mc/sec and 8.2 Mc/sec, and molar volume between 19.5 cm^3 and 20.6 cm^3. The values of the exchange parameter, J, have been determined from analysis of the frequency dependence of the relaxation times and from the rate of increase of T_1 at low temperatures with decreasing temperature due to the exchange-lattice bottleneck. In the b.c.c. phase ($J/2\pi$) is found to vary from 0.7±0.1 Mc/sec for the molar volume of 20.1 cm^3 to 35±5 Mc/sec for the molar volume of 24.6 cm^3. When the results are compared with the theories of Kubo and Tomita, and Hartmann, it is found that in the b.c.c. phase the Gaussian approximation for the exchange correlation function is not entirely accurate; in the h.c.p. phase, however, the theoretical predictions for the frequency variation of T_1 and T_2 are confirmed within the error of the experiment. Dissert. Abstr.

N68-25311 Tennessee Univ., Knoxville.

PHOTOELECTRIC AND OPTICAL PROPERTIES OF COMMERCIAL PLATINUM, GOLD AND PALLADIUM FOILS AND EVAPORATED ALUMINUM AND SILVER FILMS IN THE EXTREME ULTRAVIOLET

James Leland Stanford (Ph.D. Thesis) 1966 115 p Available from Univ. Microfilms: HC$5.60/MF$3.00 Order No. 67-1379

Photoelectric and optical properties of commercial foils of platinum, gold and palladium and evaporated films of aluminum and silver have been studied in the extreme ultraviolet region of the spectrum. From the results of this study, information about electron mean free paths and electron energy losses, characteristic of particular metals studied, has been obtained. Photoelectric yields were obtained from the measured current of electrons emitted by samples irradiated with monochromatic light of known intensity and from the measured absorption of light in the samples. Photoelectron energy distributions were determined by graphically differentiating curves of photoelectron current as a function of collector voltage. From the measured reflectances and a knowledge of the state of polarization of the incident light beam, the optical constants of the samples were obtained. The results of measurements on commercial foils are in reasonably good agreement with similar results reported in the literature. Dissert. Abstr.

N68-25392*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ANNEALING OF HIGH ENERGY PROTON DAMAGE IN SILICON

Marvin E. Beatty, III and Gerald F. Hill 30 Mar. 1967 20 p refs Presented at 6th IEEE Photovoltaic Specialists Conf., Cocoa Beach, Fla., 28–30 Mar. 1967

(NASA-TM-X-59638) CFSTI: HC$3.00/MF$0.65 CSCL 20L

The results of studies using n- and p-type silicon irradiated with 22, 40, and 158 MeV protons and annealed at 100°C, 200°C, and 300°C are reported. The results show that proton damage is very complex and difficult to anneal in comparison to electron damage. A flux dependence was found for protons which is compared to one previously reported with electrons. There is also an energy dependence result reported. A peculiar effect of increasing and decreasing minority carrier lifetime observed during isothermal annealing is discussed. Author

N68-25394 Utah Univ., Salt Lake City.

EFFECTS OF PRESSURE ON ELECTRICAL PROPERTIES OF CRYSTALLINE BORON

Onnig H. Bezirjian (Ph.D. Thesis) 1967 88 p Available from Univ. Microfilms: HC$4.60/MF$3.00 Order No. 67-3130

Tetragonal and beta-rhombohedral forms of crystalline boron were prepared by the filament method. Density measurements by the floatation method gave an average value of 2.345gms/cc for the tetragonal form, and 2.356gms/cc for the beta-rhombohedral form. Electrical resistances of the prepared samples as well as of commercial beta-rhombohedral samples were measured at the static pressures of 1–60kb and at the temperatures of 25–300°C. The decrease in Hall constants with temperature and pressure is explained in terms of the increase in carrier concentrations. It was found that in the temperature and pressure range of this investigation only positive carriers predominated. It was found that the Hall constants decreased as the resistance of the samples decreased. This result is in agreement with the observed increase in the carrier concentrations with increase in temperature and pressure. Dissert. Abstr.

N68-25492# California Univ., Livermore. Lawrence Radiation Lab.

SCINTILLATION CHARACTERISTICS OF THIN NAI (TL) AND CSI(TL) LAYERS FABRICATED BY VACUUM DEPOSITION

Rudolph W. Bauer and Richard C. Weingart 19 Feb. 1968 13 p refs Presented at the 11th Scintillation and Semicond. Counter Symp., Washington, D.C., 28 Feb.–1 Mar. 1968

(Contract W-7405-eng-48)

(UCRL-70773; Conf-680207-1) CFSTI: HC$3.00/MF$0.65

The scintillation characteristics of thin vacuum-deposited layers of NaI(T1) and CsI(T1) were investigated. Scintillation layers with thicknesses ranging from 0.2 to 20 mg/cm^2 were evaluated as detectors with 6- and 22-keV x-rays. In this energy region they were found to be comparable in performance to the thicker, commercially available NaI(T1) and CsI(T1) scintillation crystals. Fabrication methods, scintillator evaluation techniques, and applications in selective low-energy x-ray detection will be reported. Author (NSA)

N68-25587# Comision Nacional de Energia Atomica, Buenos Aires (Argentina).

THERMAL CONDUCTIVITY OF Zn POLYCRYSTALS [CONDUCTIVIDAD TERMICA DEL Zn POLICRISTALINO]

J. M. Cotignola, F. de la Cruz, M. E. de la Cruz, and R. P. Platzeck 1967 23 p refs In SPANISH supported in part by NSF

(CNEA-202) CFSTI: HC$3.00/MF$0.65

Thermal conductivity measurements were made of polycrystal zinc in the 0.12° to 0.9°K range, both in the normal state and in the superconductor, to determine its properties as a thermal conductor. It was found that the normal state follows a linear law with the temperature, while the superconductor has a behavior characteristic of conduction by electrons. Upon applying a magnetic field to carry the sample to the normal state, magnetoresistant effects were observed. Consequently, more careful measurements were made, applying fields from less than 100 to 5000 oersted, verifying a strong dependence of the conductivity on the field. Finally, measurements were made of the electrical conductivity at liquid helium temperatures. It was verified that at these temperatures, it was inside the zone of residual resistance. Also measured was the effect of magneto-resistance and its dependence on the relative orientation between field and current. Results show that zinc can be used as a thermal conductor below 1°K. However, to carry it to the normal state, it cannot be subjected to fields much greater than the critical field. Transl. by R.N.A.

N68-25605# Ohio State Univ., Columbus.

HEAT CAPACITY AND OTHER PROPERTIES OF SOLID HELIUM

Robert Clay Pandorf (Ph.D. Thesis) Ann Arbor, Mich. Univ. Microfilms 1967 178 p refs CFSTI: HC$3.00/MF$0.65

Specific heat experiments on solid helium are reviewed, and the experimental apparatus and procedure are presented for the study of the heat capacity and other properties of hexagonal close-packed (hcp) and body-centered cubic (bcc) helium 4. Melting properties, compressiblity and expansion coefficient, elastic

properties, and temperature dependence of θ are discussed for the hcp He; and specific heat, entropy, phase diagram, compressibility, expansion coefficient, and elastic anistropy for the bcc He. Attention is also given to the electronic bridge, filament supply circuit, calorimeter heater circuit, measurement of molar volume, analysis of the recording of a specific heat point, and the computer calculation of specific heat. M.W.R.

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N68-24748# Bureau of Mines, Pittsburgh, Pa.
ELECTRIFICATION OF AMMONIUM NITRATE IN PNEUMATIC LOADING
Elton L. Litchfield, M. H. Hay, and J. S. Monroe Jun. 1968 23 p refs
(BM-RI-7139)

The electrification of ammonium nitrate-fuel oil (AN-FO) blasting agents by pneumatic loaders is described and discussed. The consequences of the electrification are considered in light of the initiation requirements of electric blasting caps. It is recommended: (1) that semiconductive loading tubing be utilized and (2) that the resistivity of the AN-FO be controlled. It is further recommended that the operator: (1) test to assure continuity of the electric detonator legwire-bridgewire-legwire circuit prior to insertion of the cap into charge or borehole; (2) keep the legwires shunted but not otherwise connected to ground during loading of the blasting agent into the borehole; (3) assure that the borehole is discharged prior to hooking up the detonator leads; (4) assure that he is himself discharged prior to handling the detonator leads; and (5) assure that the blasting cap leads are never carried to the AN-FO loader. Author

N68-25169# Naval Ordnance Station, Indian Head, Md. Research and Development Dept.
APPLICATION OF SWELLING TECHNIQUES TO PROPELLANTS AND BINDERS
Irene P. Mosher and Joseph G. Tuono 1968 25 p refs Presented at the Spring Meeting, Rubber Chem. Div., Am. Chem. Soc., Montreal, Can., 5 May 1967
(AD-667250)

The utility of swelling tests in studies of highly-filled solid propellants and their corresponding binders is shown. The solubility parameters for two propellants are shown to be the same as those of the corresponding binders. The use of swelling measurements as a quality control technique for solid propellants is indicated. The proper selection of the solvent is critical for crosslink density determinations with a highly filled elastomer. The chemical changes occurring in propellant binders during high-temperature aging programs may be qualitatively explained by swelling tests and quantitatively determined by the determination of the compression modulus of swollen samples. Author (TAB)

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N68-24572*# Minnesota Univ., Minneapolis. Dept. of Mechanical Engineering.
A THEORETICAL STUDY OF COMBUSTION AND QUENCHING OF SOLID PROPELLANT ROCKET MOTORS DURING DEPRESSURIZATION
Edward A. Fletcher and Tsuyoshi Hikoki 15 Jan. 1968 80 p refs
(Contract NAS3-6294)
(NASA-CR-72397) CFSTI: HC $3.00/MF $0.65 CSCL 21B

The conservation equations in the solid and gas phases are coupled with the chamber overall mass balance equation to produce a method of computing transient burning rates in solid propellant motors. This method is used to compute burning rates during rapid depressurizations achieved by suddenly enlarging the exhaust nozzle. A nondimensional parameter characterizing the depressurization rate, D_S, is used to correlate the results. During depressurizations, burning rates are smaller than the steady state values at the corresponding chamber pressures. A quench occurs when the depressurization parameter, D_S, exceeds some critical value D_{SC}. The quench limit of a propellant can be given as a single curve on the D_S–P_2/P_1 plane, where P_1 is the initial chamber pressure and P_2 is the steady operating pressure corresponding to the enlarged nozzle areas. The results are in reasonable agreement with experiments. The effects of several variables on the quench limit are discussed. Ways of improving the present theory are suggested. Author

N68-24614*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STUDY OF UNDEREXPANDED EXHAUST JETS OF AN X-15 AIRPLANE MODEL AND ATTACHED RAMJET ENGINE SIMULATOR AT MACH 6.86
Earl H. Andrews, Jr. and R. Clayton Rogers Washington May 1968 refs
(NASA-TM-X-1571) CFSTI: HC $3.00/MF $0.65 CSCL 21H

An investigation was conducted using a 0.02-scale model of the X-15 airplane with a ramjet engine simulator attached to the underside of its afterbody. The investigation was initiated to approximate the effects of the ramjet exhaust plume upon the external pressures of a nozzle extension of an X-15 engine. The nozzle extension was tested with and without a simulated manifold designed to collect and to eject overboard auxiliary gases from the X-15 airplane. The presence of the ramjet and its pylon tended to cause the afterbody surface pressures on the X-15 airplane to remain constant and not be affected by underexpanded exhaust plumes of the X-15 and ramjet nozzles. The pressure-measuring station nearest the base of the X-15 afterbody did, however, experience an increase as the exit-to-ambient static-pressure ratio of the X-15 nozzle increased. Static-pressure measurements and schlieren photographs indicated that the ramjet nozzle exhaust plume initially impinged upon the nonblowing X-15 nozzle extension at very small ratios of ramjet nozzle-exit pressure to ambient static pressure of 8 and 12 for angles of attack of 0° and 3°, respectively. Upward forces on the X-15 nozzle extension caused by operation of the ramjet nozzle were approximated; the forces without the manifold ring were greater than those with the ring. Author

N68-24626*# Chrysler Corp., New Orleans, La. Space Div.
FINAL FLIGHT PERFORMANCE PREDICTION FOR SATURN AS-205 PROPULSION SYSTEM S-1B-5 STAGE
R. M. Cordes 1 Apr. 1968 36 p refs
(Contract NAS8-4016)
(NASA-CR-94697; TR-P&VE-66-34, Rev. B) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Analysis of the revised final prediction data indicate that inboard and outboard engine cutoffs will occur approximately 140.61 seconds and 143.61 seconds after first motion, respectively. These times are based on defined fuel and LOX load specific weights, and stage propellant fill weights for the revised launch schedule for AS-205. Author

N68-24685# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany).

THE EFFECT OF THE INJECTION PROCESS ON THE OPERATIONAL BEHAVIOUR OF SMALL ROCKET ENGINES. PART 1: HYDRODYNAMIC REGULARITIES WITH PROPELLANT INJECTION BY MEANS OF IMPINGING JETS [DER EINFLUSS DES EINSPRITZVORGANGES AUF DAS BETRIEBSVERHALTEN KLEINER FLUESSIGKEITSRAKETEN]

H. Hartung Feb. 1968 32 p refs In GERMAN; ENGLISH summary

(DLR-FB-68-17) CFSTI: HC $3.00/MF $0.65

Cold flow studies on doublet and triplet impinging jets were conducted to define the major variables affecting the mixing and distribution of the injected propellants. The well known criteria for optimum mixing of the doublet impinging jets are confirmed by an analytical model of the mixing process. Investigations on the triplet impinging jets show a similar relation for optimum mixing. But in this case the data indicate a clear effect of the included impingement angle. Author

N68-24688# Bolkow Entwicklungen K. G., Munich (West Germany).

ANALYSIS OF NUCLEAR ELECTRIC PROPULSION SYSTEMS FOR MISSIONS TO OUTER PLANETS [ANALYSE VON NUKLEARELEKTRISCHEN RAUMFAHRTSYSTEMEN FUER MISSIONEN ZU EINIGEN AUEBEREN PLANETEN]

K. Krumm Bad Godesberg, West Ger. Bundesmin. fuer Wiss. Forsch. Feb. 1968 43 p refs In GERMAN; ENGLISH summary

(BMwF-FB-W-68-14) CFSTI: HC $3.00/MF $0.65

A computer program was devised to determine the optimal design data of space vehicles propelled by a nuclear electric rocket for missions from a parking orbit around Earth to orbits of some outer planets. This program optimizes (for maximum final mass) the magnitude and direction of thrust, which is zero in the coasting phase or equal to a value determined by the constant electric thrust and fixed specific impulse of the engine that can be switched on and off. Space vehicles for missions to Jupiter, Saturn, Mars, and Neptune with initial weights of 2000, 4000, and 13,000 kg in an Earth parking orbit of 500 km and a specific mass dependent on the electric power were analyzed. Author

N68-24851 Texas Univ., Austin.

A THEORETICAL MODEL FOR BASE FLOW IN MULTI-NOZZLE ROCKETS

Carl Samuel Lenzo (Ph.D. Thesis) 1966 101 p

Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-3314

The requirement for lifting ever increasing payloads into space has resulted in rocket vehicle configurations which employ more than one thrust chamber (or rocket motor). While such configurations have yielded increased thrust, they have also introduced numerous operation problems because of their added complexity. One of the more prominent of these problems is known as base heating. This is the term commonly applied to the heating of the lower part of a vehicle due to the interaction of the hot exhaust plumes from closely spaced rocket nozzles. It has been found that base heating is due to radiation from the exhaust gas plumes and to convection from hot gas recirculated into the base region. Along with this thermodynamic problem, there is a corresponding one of vehicle dynamics which requires a knowledge of the aerodynamic loading (in this case drag) due to the pressure field at the base of the vehicle. This base flow problem has been encountered in vehicles such as the Polaris, Minuteman and Saturn (first and second stages). Dissert. Abstr.

N68-24974*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

DESIGN, FABRICATION, AND TESTING OF THE APPLICATIONS TECHNOLOGY SATELLITE APOGEE MOTOR CHAMBER

V. F. Lardenoit, B. K. Wada, and D. P. Kohorst 1 Nov. 1966 84 p

(Contract NAS7-100)

(NASA-CR-94668; JPL-TM-33-309) CFSTI: HC $3.00/MF $0.65 CSCL 21H

On firing, the apogee motor provides the necessary impulse to place the satellite in near synchronous orbit. The choice for the chamber material was Ti-6Al-4V alloy. An optimum design was achieved by a team effort among materials, structures fabrication, propulsion, and design personnel. Certain tradeoffs that were required are discussed in detail. The chamber consists of two half shells and a mounting ring. Fabrication was accomplished by forging to shape, machining to the desired thickness, and welding of the components. Verification of chamber design was determined from hydroburst test, vibration tests, and acceleration tests. Author

N68-24990# Rugby Coll. of Engineering Tech. (England).

A COLLECTION OF NOTES ON DIESEL ENGINE ECONOMICS

P. J. Lawrence 1967 105 p refs

(Rept.-1) CFSTI: HC $3.00/MF $0.65

Design and developments of 4 stroke Diesel engines over the past fifteen years are surveyed for some twenty engines in the speed range 800 to 1800 rev. per minute with emphasis on engine size. Graphs depict the trend in piston speed and engine outputs in terms of H.P./in.^{2} of piston area as a function of mean effective pressure. An effort is made to predict possible effects of thermal ratings on engine costs and weight. Also covered is residual fuel burning in its context of economic importance for electricity generation and marine propulsion. G.G.

N68-25099*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MANAGEMENT OF CRYOGENIC PROPELLANTS IN A FULL SCALE ORBITING SPACE VEHICLE

Raymond F. Lacovic, Frederick C. Yeh, Steven V. Szabo, Jr., R. J. Brun, Andrew J. Stofan et al Washington May 1968 69 p refs

(NASA-TN-D-4571) CFSTI: HC $3.00/MF $0.65 CSCL 21H

The fourth and eighth Atlas-Centaur vehicles were launched to study cryogenic propellant management during coast. Kinetic energies imparted to the liquid hydrogen at first engine cutoff caused liquid motion within the hydrogen tank resulting in subsequent venting of liquid hydrogen rather than gaseous hydrogen. The vented liquid impinged on the vehicle causing it eventually to tumble out of control. Energy dissipators were installed on the hydrogen tank pressurization line and boost pump return flow lines. A balanced thrust hydrogen vent system was installed to reduce vehicle disturbances. A slosh baffle was installed in the hydrogen tank and a thrust schedule for propellant settling and retention was established. These modifications reduced the total kinetic energy at first engine cutoff from 200 foot-pounds (270 J) to less than 50 foot-pounds. Information obtained on heat inputs to the tank was used to establish the capability of the hydrogen vent system. Also, a thermal survey was made of the hydrogen tank ullage; this survey provided information on temperature stratification of the ullage gas. The flight demonstrated a practical method for control of a cryogenic propellant in a full-scale orbiting space vehicle. The method of propellant control established for the Centaur vehicle is applicable to any space vehicle having short-term storage of cryogenic propellants in space. Author

N68-25108*# Atlantic Research Corp., Alexandria, Va.

LUNAR EXCURSION MODULE PROPULSION SYSTEMS VALVE ACTUATING TESTS Final Report, 7 Apr.-23 Jul. 1966

Ralph D. Gift, Jack M. Spurlock, John A. Simmons, and Jaydee M. Miller 29 Jul. 1966 76 p
(Contract NAS9-5937)
(NASA-CR-62075) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Performance data are presented on the vacuum environment operations of the propellant valve actuating systems for the LEM (lunar excursion module) descent and ascent engines. Attention was focused on the extent to which adverse effects could be produced by evaporatively frozen propellant in the vent lines of the systems, and on the development of remedial techniques for reducing such effects. Normal mission duty-cycle, leak, and remedial tests were conducted; the working fluid was a 1:1 mixture of hydrazine and unsymmetrical dimethylhydrazine. Among the conclusions drawn are: (1) Application of heat to the vent line can be an effective deterrent of blockage due to evaporative freezing. However, the amount of heat required for various missions and leakage situations must be determined. (2) Actuator system operation will not be affected as long as the propellant in the actuator can be expelled into the vent line by the spring actuated piston. If blockage should occur, the number of cycles that could be successfully completed is a function of the ratio of the volume of the vent line to the volume of the actuator. M.G.J.

N68-25279*# National Aeronautics and Space Administration, Washington, D. C.
SURVEY PAPER ON VTOL PROPULSION COVERING RESEARCH PROBLEMS IN ATTAINING PROGRESSIVE TECHNOLOGICAL ADVANCEMENT
Michael B. Comberiate 13 Sep. 1967 37 p refs Presented at AGARD Specialists' Meeting on Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds, Goettingen, W. Ger., 11–13 Sep. 1967
(NASA-TM-X-60507) CFSTI: HC $3.00/MF $0.65 CSCL 21E

The main propulsion characteristics affecting the usefulness of vertical takeoff and landing aircraft are similar to those of conventional aircraft, except their influence is stronger. The historic progress in cruise specific fuel consumption, specific weight and specific volume are examined, and predictions made for near future characteristics. The basic gas burbine engine component technology, and engine cycle improvements necessary to attain the engine performance progress are discussed in some detail. Some problems associated with VTOL propulsion system installation are also discussed. Author

N68-25302# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany).
OPTIMISATION OF WEIGHT AND EXHAUST VELOCITY OF ELECTROSTATIC PROPULSION SYSTEMS FOR THE STABILIZING OF THE ORBIT OR POSITION OF SATELLITES [OPTIMIERUNG VON GEWICHT UND TREIBSTOFFAUSTRITTSGESCHWINDIGKEIT BEI ELEKTROSTATISCHEN]
H. Bessling Dec. 1967 24 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-87) CFSTI: HC $3.00/MF $0.65

The deviations of the position or orbit of a satellite caused by disturbances can be compensated by electrostatic ion motors. For the construction of these thrustors the best exhaust velocity of the propellant mass is of utmost importance. For the driven, otherwise powerfree flight, the best value follows the Stuhlinger-equation. Here, in the case of the compensation of disturbances an equation for the best exhaust velocity with different quantities as parameter like specific power of energy supply, the operating time and so on, is deduced, and an example of application is calculated, in which the energy supply for the stabilization thrustor is additionally applied. This analysis was made to receive a foundation for an experimental device of an electrostatic propulsion with arc discharge ion source. Author

N68-25373# Rugby Coll. of Engineering Tech. (England).
SOME ASPECTS OF DIESEL ENGINE THERMO-DYNAMIC DESIGN
M. C. Bennett Jul. 1967 134 p refs
(DED-2-MCB-1) CFSTI: HC $3.00/MF $0.65

A new approach to thermodynamic design of diesel engines is described. Also considered is the use of ideal cycles in predicting actual engine performance. Two proposals for influencing and controlling the peak cylinder pressures and temperatures are given. The first deals with the effect of placing the crankshaft eccentrically to the cylinder axis. The second method considers the use of a second smaller piston and crank mechanism which can be variably phased to the larger mechanism. S.C.W.

N68-25418*# Westinghouse Electric Corp., Dayton, Ohio. Astronuclear Lab.
CALCULATION OF TRAJECTORIES OF ATOMIZED DROPS IN WET VAPOR TURBINES
T. C. Varlijen 20 Dec. 1967 20 p refs Prepared for JPL
(Contract NAS7-390)
(NASA-CR-94708; WANL-TME-1711) CFSTI: HC $3.00/MF $0.65 CSCL 21B

In continuing analyses of turbine blade erosion, equations of motion are formulated to determine the aerodynamic forces on a detached droplet, and to calculate the drag coefficient for distorted droplets. A nonlinear differential equation is given for solving the required primary droplet trajectories. It is pointed out that aerodynamic forces on the relatively large primary drops will cause further disruption of most of these drops in a secondary atomization process. Also considered are methods of estimating the width of the stator wake, its inclination with respect to the axis of the turbine, and the vapor velocity profile across the wake, as functions of axial distance (downstream) between the blade rows. The MIMIC source language program, which provides digital solutions to systems of ordinary differential equations, is listed. Typical problem input and output data are defined, and a sample problem output is included. A.L.

N68-25575# Lockheed Missiles and Space Co., Sunnyvale, Calif.
DYNAMICS PORTION OF GEMINI AGENA TARGET VEHICLE ENGINE MODIFICATION AND TEST PROGRAM (PROJECT SURE FIRE)
Nicholas Angelopulos *In* NRL The Shock and Vibration Bull., No. 37, Pt. 2 Jan. 1968 p 117–171 ref (See N68-25561 14-32)

Project Sure Fire was established to develop corrective improvements for, and demonstrate the flightworthiness of, the rocket engine designed for the Gemini Agena target vehicle; the rocket engine had failed during its first flight. There were four basic objectives for the dynamics portion of Project Sure Fire. (a) The first objective was to determine if the modified (oxidizer-lead) engine start transient dynamic characteristics are similar to or significantly different from the standard engine configuration. Dynamic measurements were recorded during acceptance testing of four YLR 81-BA-11 (standard) and three XLR 81-BA-13 (multistart) engines. (b) The second objective was to demonstrate, in shock and vibration testing of an XRM-4 engine, the structural integrity of the modified-engine installation design changes resulting from the program. (c) The third was to evaluate, in engine hot-fire tests, shock and vibration levels at specific points on the modified engine during engine start transient and ignition sequence. (d) The fourth was assessment of test results (PSD, shock spectra, rms g history, force-time plots, etc.), as well as of methods of obtaining good shock transient data (accelerometers vs strain gages). Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N68-24528*# California Univ., Berkeley. Space Sciences Lab.
A SPATIO-TEMPORAL ANALYSIS OF VELOCITY FIELDS IN THE SOLAR PHOTOSPHERE
Edward N. Frazier 24 Jan. 1968 31 p refs Submitted for publication Sponsored in part by Deut. Forschungsgemeinschaft
Its Ser. 9, Issue 6
(Grants NsG-243; NGR-05-003-230; Contract Nonr-3656(26))
(NASA-CR-94710; AD-666621) CSCL 03B

A series of high (spatial) resolution spectrograms were taken of the center of the solar disk at Kitt Peak National Observatory, U.S.A. The spectrograms were taken every 20 seconds for 55 minutes. The Doppler shifts of the absorption lines, as well as the intensity fluctuations, both in the continuum and in the lines, were subjected to a simultaneous spatial and temporal Fourier analysis. The results are displayed in the form of contour lines k - omega plane, or diagnostic diagram. These results clearly show convective overshoot at all levels of the photosphere. They also show that the well known 5 minute oscillations are primarily standing resonant acoustic waves. The gravity wave mode was not observed. Arguments are presented suggesting that the oscillations are not formed directly from the piston action of a convective cell impinging on the stable photosphere, but rather are formed within the convection zone itself. Author (TAB)

N68-24668*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE INTER-RELATIONSHIP OF COSMIC RAY ANISOTROPIES AND THE INTERPLANETARY MAGNETIC FIELD
K. G. McCracken (Adelaide Univ.), U. R. Rao (Phys. Res. Lab., Ahmedabad), and N. F. Ness Nov. 1967 19 p refs
(NASA-TM-X-63208; X-612-67-584) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The direction of the cosmic ray anisotropy during solar proton events and the concurrent direction of the interplanetary magnetic field vector are compared using data obtained in 1966 by the Pioneer VI spacecraft. It is shown that the non-equilibrium cosmic ray anisotropy (normally observed to exhibit an amplitude in the range 20–50%) is field aligned, while the equilibrium anisotropy (normally observed to exhibit an amplitude in the range 5–15%) is independent of the direction of the magnetic field vector. Two anomalous proton events during which pronounced anisotropies were observed with their maximum cosmic ray fluxes directed towards the sun are discussed. It is shown that during these proton events there were synchronous reversals of 180° in the direction of the magnetic field vector, and the cosmic ray anisotropy direction, in association with the passage of a magnetic sector boundary past the spacecraft. These observations are interpreted as possible evidence for their being a complex loop in the magnetic field. Author

N68-24695# Osservatorio Astronomico di Roma (Italy).
SOLAR PHENOMENA
Massimo Cimino Apr. 1968 22 p *Its* Monthly Bull. No. 124
CFSTI: HC $3.00/MF $0.65

Data tables and graphics are presented on the daily total areas of sunspot groups: the heliographic position, classification, and area of sunspot groups; longitudinal sunspot magnetic fields; the hours of K-line and H_α cinematographic patrols; the sudden cosmic noise absorption; and the sudden enhancement of atmospherics. M.G.J.

N68-24727*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RELATIVISTIC ELECTRONS FROM SOLAR FLARES
T. L. Cline and F. B. McDonald May 1968 47 p refs
(NASA-TM-X-63210; X-611-68-154) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Observations of interplanetary relativistic electrons from several solar flare events monitored through 1964 to mid-1967 are presented. The 3- to 12-MeV electrons detected have kinetic energies about two orders of magnitude higher than those solar electrons previously studied in space, and measurements of both the time histories and energy spectra for a number of events in the present solar cycle were carried out. These measurements of interplanetary electrons are also directly compared with solar X-ray data and with measurements of related interplanetary solar protons. The time histories of at least four electron events show fits to the typical diffusion picture. A demonstrated similarity between the electron and the medium-energy proton fits for the event of 7 July, in particular, indicates that at these electron energies, but over several orders of magnitude of rigidity, whatever diffusion does take place is very nearly on a velocity, rather than a rigidity or an energy, basis. Diffusion-fit time histories varied as a function of T_o also indicate that the electrons in certain flare events originate at times near the X-ray and microwave burst, establishing their likely identity as the same electrons which cause the impulsive radiations. Author

N68-24745# Smithsonian Astrophysical Observatory, Cambridge, Mass.
THE PRODUCTION OF COSMIC GAMMA RAYS IN INTERSTELLAR AND INTERGALACTIC COSMIC-RAY COLLISIONS. 3: THE FORM OF THE COSMIC GAMMA-RAY SOURCE SPECTRUM FROM P-P INTERACTIONS FOR GAMMA-RAY ENERGIES LESS THAN 1 GEV
F. W. Stecker 19 Dec. 1967 39 p refs
(NP-17315; SAO-260) CFSTI: HC $3.00/MF $0.65

The cosmic gamma spectrum below 1 GeV arising from p-p interactions is calculated. Its properties are determined by the properties of secondary neutral pion production occurring at accelerator energies. First a detailed discussion of the general properties of the gamma spectra arising from neutral pion decay is given. A determination is made of the various features of such spectra that must, in general, hold true. This discussion includes the results of analytic calculations of normalized gamma spectra from ideal neutral pion energy distributions. An "isobar-plus-fireball" model is then chosen for numerical calculations in which the two dominant modes of neutral pion production at accelerator energies are production of the $N^*_{3/2}$ (1237) isobar and one fireball. Each of these modes of production then yields a component to the total gamma spectrum. The components are summed and the results are given in terms of integral and differential gamma spectra. A comparison is made with recent balloon data of gamma rays resulting from the atmospheric high-energy interactions, and good agreement is found. Author (NSA)

N68-24786 Joint Publications Research Service, Washington, D. C.
POLISH COSMIC EXPERIMENT IN SOLAR RADIATION
Krzysztof Baranowski 16 May 1968 6 p Transl. into ENGLISH from Trybuna Ludu (Poland), Apr. 16, 1968 p 4
(JPRS-45403) CFSTI: $3.00

The limited role of Polish experiments dealing with solar radiation is noted, and it is emphasized that all of efforts within the Soviet-bloc make for an important and fact-finding combined effort. Mention is made of the Astronomical Institute at Wroclaw and its facilities; as well as of the aluminum windows for various cameras, the relationship of sunspots to other phenomena, and the study of X-rays in the solar corona. M.W.R.

N68-24808# Siemens-Schuckertwerke A. G., Erlangen (West Germany).
SIMULATION OF THE RADIATION DAMAGE IN THE VAN ALLEN BELT, ESPECIALLY FOR THE RESEARCH SATELLITE 625 A-1 [BERECHNUNG DER STRAHLENBELASTUNG IM VAN-ALLEN-GUERTEL DISKUTIERT AM BEISPIEL DES FORSCHUNGSSATELLITEN AZUR]

K. Wohlleben Aug. 1967 63 p refs
(BMwF-FB-W-68-18) CFSTI: HC $3.00/MF $0.65

A computer program is described for calculating the spectra of the protons and electrons along an elliptical satellite orbit from the spatial distribution of both particles in the Van Allen radiation belt. The ionization and the defect concentration produced in the silicon and the damage to solar cells are calculated in dependence of the shield thickness by further programs. The computations were also carried out numerically for four orbits with different altitudes of the apogee of the satellite 625 A-1. The author shows that the radiation damage in the Van Allen belt can be faithfully simulated in the laboratory test with 1 MeV electrons and 3 MeV protons. Comparisons are made of the screening effect of materials of various nuclear charge numbers. Author

N68-24813# Smithsonian Astrophysical Observatory, Cambridge, Mass.
THE PRODUCTION OF COSMIC GAMMA RAYS IN INTERSTELLAR AND INTERGALACTIC COSMIC-RAY COLLISIONS. 4: GAMMA-RAY PRODUCTION FROM COSMIC PROTON–ANTIPROTON INTERACTIONS
F. W. Stecker 20 Dec. 1967 28 p refs
(NP-17316; AO-261) CFSTI: HC $3.00/MF $0.65

Various cosmological situations are discussed in which the annihilation of antimatter will produce cosmic gamma rays. An upper limit is placed on the amount of cosmic matter-antimatter interaction consistent with recent cosmic gamma-ray observations. It is shown that the production of mesons other than pions have little effect on the annihilation gamma-ray spectrum. It is also shown that gamma rays arising from annihilations at rest have energies between 5 and 865 MeV. The gamma-ray spectrum from annihilations at rest is calculated and compared with the calculations of Frye and Smith. A discussion is then presented of the various characteristics of proton–antiproton interactions in flight. Production of various mesons, hyperons, and isobars is discussed and cross sections are given. General implications of the data on the resultant gamma spectra are stated. Author (NSA)

N68-24829# Smithsonian Astrophysical Observatory, Cambridge, Mass.
THE PRODUCTION OF COSMIC GAMMA RAYS IN INTERSTELLAR AND INTERGALACTIC COSMIC-RAY COLLISIONS. 5: GAMMA-RAY PRODUCTION FROM COSMIC ELECTRON-POSITRON ANNIHILATION
F. W. Stecker 21 Dec. 1967 23 p refs
(NP-17317; SAO-262) CFSTI: HC $3.00/MF $0.65

The annihilations of free electrons, positrons, and positronium are discussed; and cross sections are given. Positronium formation under astrophysical conditions is then discussed. A general formula is then derived that gives the gamma spectrum from the annihilation of cosmic positrons, in terms of the positron source spectrum, energy loss rate, and annihilation cross section, given as functions of energy. The gamma spectrum for the annihilation of thermal positrons is calculated, and the gamma intensity from secondary positrons is determined. The secondary positrons are considered to arise from the decay of positive mesons that are produced in galactic cosmic p-p and p-α interactions. Author (NSA)

N68-25030 Utah Univ., Salt Lake City.
ELECTROMAGNETIC CASCADE SHOWERS FROM COSMIC RAY MUONS IN DENSE MATERIAL
Lyle Kent Hilton (Ph.D. Thesis) 1967 72 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-3231

Two large area water Cerenkov counters were used in conjunction with several rows of cylindrical spark counters to detect electromagnetic cascade showers from cosmic ray muons. The trajectory of the muon could be determined to within one degree using the localized discharges in the spark counters. Eastward and westward going shower events having 40 to 120 or more particles in water from 0° to 30° above the horizon are presented in 10 degree groupings. The plot of rate of showers received versus number of particles in the shower falls off faster than the theoretical curve. The region of discrepancy is for energy transfers of approximately 50 GeV and greater. Dissert. Abstr.

N68-25069 Utah Univ., Salt Lake City.
HIGH ENERGY MESON PRODUCTION IMPLICATIONS FROM OBSERVING THE COSMIC RAY LUNAR SHADOW
Calman Jacob Wolfson, II (Ph.D. Thesis) 1967 104 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-3133

A data-handling system designed for use with the Utah neutrino detector is described. This system is capable of handling a large number of cosmic-ray events, each having many parameters, and yielding the data in a digital form suitable for direct analysis on a computer. Using this prototype detector an observation of the cosmic-ray lunar shadow was attempted. By using the magnetic field of the earth as a huge spectrometer and observing the bendings of the primary "shadow protons" and secondary "shadow muons," information concerning high (>100 BeV) energy nucleon–nucleon collisions was sought. The results indicated an effective lunar cross section for primary nucleons whose magnitude was about 5 times greater than that expected from simple geometrical considerations. No explanation was obtained. Finally, treating the effect as a lunar shadow, the ratio of primary proton energy to resulting pion energy was found to be about 25. This result is consistent with the Pal and Peters's production model. Dissert. Abstr.

N68-25181*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EXTERNAL AERODYNAMICS OF THE MAGNETOSPHERE
John R. Spreiter, Alberta Y. Alksne, and Audrey L. Summers Washington June 1968 73 p refs Presented at the Summer Inst. for Phys. of the Magnetosphere, Chestnut Hill, Mass., 19–28 Jun. 1967
(NASA-TN-D-4482) CFSTI: HC $3.00/MF $0.65 CSCL 04A

A unified basis for the entire discussion is provided by the equations of magnetohydrodynamics, augmented by relations from kinetic theory for certain small scale details of the flow. While the full complexity of magnetohydrodynamics is required for the formulation of the model and the establishment of the proper conditions to apply at the magnetosphere boundary, it is shown that the magnetic field actually experienced in space is usually sufficiently small that an adequate approximation to the solution can be obtained by first solving the simpler equations of gasdynamics for the flow and then using the results to calculate equations of gasdynamics for the flow and then using the results to calculate the deformation of the magnetic field. Numerous specific results are presented, including those for conditions in the solar wind, the shape of the magnetosphere boundary, and the flow and magnetic fields around the magnetosphere. The calculated results are compared with data obtained by numerous spacecraft, including Explorer 12, IMP-1, Pioneers VI and VII, and the Vela satellites. Author

N68-25424 St. Louis Univ., Mo.
INTERPRETATIONS OF DIRECTIONAL FLUX DENSITIES IN ARGUS SHELLS, EXPLORER 4 SATELLITE DATA
Joseph Manuel Paikeday (Ph.D. Thesis) 1966 201 p
Available from Univ. Microfilms: HC $9.25/MF $3.00 Order No. 67-2963

A method of computing directional flux density of geomagnetically trapped particles from the directional counting rate obtained from Explorer IV, Satellite 1958 Epsilon is developed. The

directional counting rate is related to the directional flux density by an integral equation whose kernel is unsymmetric and ill-conditioned. It has been found that the known methods of solving the integral equation when applied to this particular problem fails to produce physically meaningful results owing to the fact that the kernel of the integral equation is highly sensitive to experimental errors inherent in the counting rate data. The present method replaces the inverse of the kernel-matrix by an approximate matrix which is insensitive to small errors in the counting rate data. Dissert. Abstr.

N68-25550# Uppsala Univ. (Sweden).
DISTRIBUTION CHANGES OF THE MESON AND NUCLEON COMPONENTS OF COSMIC RAYS AND SOLAR ACTIVITY
Bengt Stensland (Ph.D. Thesis) 1967 20 p refs *Its* Acta Univ. Upsaliensis Abstr. of Uppsala Dissertations in Sci. 105
CFSTI: HC $3.00/MF $0.65

Summary results are given from various studies conducted to determine to the secondary effects of the bombarding of the atmosphere by primary cosmic rays. The studies include (1) directional distribution of the cosmic ray meson component and solar activity, (2) cosmic ray anisotropy associated with storm sudden commencements, (3) cosmic ray perturbations associated with solar activity, and (4) perturbation of the neutron component of cosmic rays during the initial phase of Forbush decreases. B.S.D.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N68-24371*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
THE EQUATIONS OF MOTION FOR OPTIMIZED PROPELLED FLIGHT EXPRESSED IN DELAUNAY AND POINCARE VARIABLES AND MODIFICATIONS OF THESE VARIABLES
William E. Miner Washington May 1968 79 p refs
(NASA-TN-D-4478) CFSTI: HC $3.00/MF $0.65 CSCL 22C

This document presents methods for developing the ordinary differential equations of motion in canonical form equivalent to the forms of Delaunay and Poincare. It also presents modifications to these forms so that three variables, which are constants of motion, result while the forms remain canonical. The equations of motion are for a vehicle propelled by constant thrust magnitude with a constant mass flow rate. The vehicle is moving in a central force field. The trajectories are optimum in the sense of classical calculus of variations in a neighborhood definable by the boundary conditions of the specific problem. Specific problems are not discussed in this document. The value of the document lies in two major areas: (1) The possible economics in numerical calculations which may result from using these ordinary differential equations, and (2) The application of the general perturbation theory of classical celestial mechanics to approximate solutions of these ordinary differential equations. Author

N68-24390*# California Univ., Berkeley. Space Sciences Lab.
INTERPLANETARY MAGNETIC FIELD IMP-1, MOTION PICTURE OF THE TRANSVERSE COMPONENTS
John M. Wilcox, Arthur Douglas Ritchie, and Norman F. Ness (NASA. Goddard Space Flight Center) 22 Jan. 1968 14 p refs *Its* Ser. No. 9, Issue No. 5
(Grants NSG-243; NGR-003-230; Contract Nonr-3656(26); Grant NSF GA-1319; Proj. No. NR 021-101)
(NASA-CR-94672) CFSTI: HC $3.00/MF $0.65 CSCL 03B

A 16 mm movie, representing a portion of the IMP-1 magnetometer observations of the interplanetary mangetic field is described. The view is parallel to the ecliptic plane, and at an angle of 50° to the earth–sun line. Thus an interplanetary magnetic field in the Archimedes spiral direction appears as a point, and the transverse variations (in the north–south direction and in the azimuthal direction) are seen. Author

N68-24422*# Mathematical Sciences Group, College Park, Md.
OPTIMAL CONTROL FOR SATELLITE ATTITUDE MANEUVERS. VOLUME 1: MATHEMATICAL ANALYSIS
G. Stephen Jones, Thomas Englar, Wallace Parr, E. V. Schuman, and Arrigo Cellina [1967] 307 p
(Contracts NAS5-10191; NAS5-10349)
(NASA-CR-94673) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Suboptimal attitude maneuvering control for synchronous earth-pointing satellites was synthesized using six degrees of freedom nonlinear dynamics for rigid body satellites being perturbed by gravity gradient and solar pressure torques and misalignment of attitude control thrustors. Noise, derived rate data, and other real effects of sensors were included in the analysis; as were thrustor real effects related to on-time delays, minimum pulse restrictions, and rise time and decay behavior. Computer programs were constructed for control synthesis and simulation purposes in the digital member of a digital-analog hybrid computer, and analogous computer software was developed for fully digital simulation study. Satellite attitude kinematics and dynamics are discussed, including transformation from one coordinate system to another. The model for optimal attitude control synthesis, simulation studies for attitude maneuvers, and detailed mathematical analyses are included. Analyses were made of ground track, solar pressure torque, gravity gradient torque, simulation of elastic booms on the satellite, and control synthesis. M.W.R.

N68-24423*# Mathematical Sciences Group, College Park, Md.
OPTIMAL CONTROL FOR SATELLITE ATTITUDE MANEUVERS. VOLUME 2: COMPUTER PROGRAMS. PART 7: DIGITAL AND HYBRID SIMULATOR COMPUTER PROGRAMS Research Report
G. S. Jones et al Apr. 1968 137 p
(Contracts NAS5-10191; NAS5-10349)
(NASA-CR-94678) CFSTI: HC $3.00/MF $0.65 CSCL 22C

A computer program was written to incorporate results from the synthesis of optimal control for satellite attitude maneuvers. Control computation is contained in a digital program and the dynamics are either digital or in an analog computer for hybrid computation in conjunction with the HYDAC 2000. The program was written in Fortran IV for the SDS 9300, with an alternate version for the IBM 7094. The digital program is described, and verification information and flow charts are included. Digital program listings are given for the ideal model, the sensor model, and the elasticity model; and the simulation model for the analog computer is described. Overall hybrid simulation along with necessary setup procedures are summarized; and analog patching is considered, including initial condition setup, dynamics and control, thrustor misalignments, and thrustor real effects and fuel consumption. M.W.R.

N68-24452 Michigan Univ., Ann Arbor.
AN ATMOSPHERIC ANALYSIS OF THE MAGNETIC STAR GAMMA EQUULEI
John Clement Evans (Ph.D. Thesis) 1966 184 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-1736

This investigation contains the results of an atmospheric analysis of the magnetic star Gamma Equulei. The observational material includes several high dispersion spectrograms as well as an energy distribution measurement. The energy distribution and the hydrogen line profiles, which correspond to an A7V star, were used to select an appropriate photospheric model for the line analysis from a computed grid of solar-type models. The computations for the model atmospheres, the line profiles, and the theoretical curves of growth were programmed for a digital computer. The conclusions from the line profiles, the curve of line width diagram, and the curves of growth are that there could be a microturbulence broadening as large as 0.5 km/sec, that there is a macroturbulence or rotational broadening of 2 to 3 km/sec, and that there is an additional broadening due to Zeeman splitting. Dissert. Abstr.

N68-24482 Texas Univ., Austin.
ON β CEPHEI STARS
Graham Hill (Ph.D. Thesis) 1966 172 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-3297

The results of a photoelectric search for β Cephei stars amongst a sample of 153 early B stars, found in the nearest associations and galactic clusters, are presented. This search yielded 24 new β Cephei stars (including 4 tentative ones), thereby increasing the number of known β Cephei stars to 41. These new observations have extended considerably the limits of spectral type, luminosity class, absolute magnitude, period, and rotational velocity. The limits now become O9.5-B3 (spectral type), V-I (luminosity class), 3–10 hours (period), 0 – > 300 km/sec (rotational velocity). An examination of the period-luminosity relation indicates that those stars with periods $<0^d.3$ obey a p-1 relation but the stars with $P \_ 0^d.4$ do not. The H–R diagrams of β Cephei variables and normal stars for individual associations and galactic clusters show that the β Cephei stars occupy no preferred position in relation to normal stars. Furthermore, a theoretical H–R diagram in which the observed β Cephei stars are placed shows that these stars fall to the right of a locus which is related to the onset of hydrogen-shell burning. Dissert. Abstr.

N68-24483 Michigan Univ., Ann Arbor.
PHOTOMETRIC DETERMINATION OF STELLAR RADII
David Frank Gray (Ph.D. Thesis) 1966 145 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-1750

A simple and accurate method is developed to measure stellar radii. Succinctly stated, one compares the observed absolute energy distribution with an energy distribution predicted from a model atmosphere computation. The radius is given by the square root of the flux ratio multiplied by the distance to the star. The radius can be determined with an uncertainty of 10% or less provided the distance to the star is well known. The method has the advantages that it uses only the observable region of the spectrum, it does not depend on bolometric corrections, and it is independent of any effective temperature scale. The energy distributions of the three visual binary stars ηCas A, ξBoo A, and 70 Oph A were measured with a grating spectrum scanner attached to the Francis C. McMath 24 inch telescope. Line absorption and hydrogen line profiles were measured on 8.9 A/mm spectrograms taken with the coude spectrograph on the Kitt Peak 84 inch telescope. Dissert. Abstr.

N68-24486*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ASPECT DETERMINATION IN LUNAR SHADOW ON EXPLORER 35
Harold E. Taylor Washington May 1968 12 p refs
(NASA-TN-D-4544) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The Explorer 35 spacecraft experiences a small, temporary secular decrease in spin period (approximately 2 parts in 1000) during every pass through the lunar shadow. Because of this, the pseudo-sun pulse, generated when the spacecraft is in the shadow, no longer accurately indicates the sunward direction. Details are given on an empirical method of fitting a spin period of the form $a + b \exp(-t/t_0)$ to the aspect information available before and after the optical shadow (t is time since the spacecraft entered the shadow, and a, b, and t_0 are constants to be determined). The resulting aspect information is estimated to be within ±10 degrees of the true direction. Author

N68-24489# Universidad Nacional de Colombia, Bogota. Facultad de Ciencias.
YEAR BOOK OF THE NATIONAL ASTRONOMICAL OBSERVATORY, 1968 [ANUARIO DEL OBSERVATORIO ASTRONOMICO NACIONAL, 1968]
1968 115 p refs In SPANISH
CFSTI: HC $3.00/MF $0.65

This 1968 edition of the National Astronomical Observatory's yearbook is similar to previous editions; however, it contains an expanded listing of stars, has an additional table on atmospheric refraction, and uses the new system of astronomical constants adopted by the International Astronomical Union. Included are data on solar and lunar eclipses; sidereal and universal time; an ephemeris and rectangular coordinates of the sun; a lunar ephemeris; phases, apogee, and perigee of the moon; ephemerides, geocentric and heliocentric phenomena, and orbital elements of the planets; rising and setting times for the sun and moon; positions of 480 stars; independent daily numbers; an explanation of some of the information used in this yearbook; the new system of astronomical constants; and some useful mathematical tables. Transl. by R.N.A.

N68-24492# Madrid Univ. (Spain). Facultad de Ciencias.
ZODIACAL LIGHT, THE LIGHT OF INTERPLANETARY SPACE [LA LUZ ZODIACAL, LUZ DEL ESPACIO INTERPLANETARIO]
Francisco Sanches Martinez 1966 15 p In SPANISH Submitted for publication
(Publ.-58) CFSTI: HC $3.00/MF $0.65

The visible aspects of the zodiacal light and a brief history of astronomical theories and studies of this phenomenon are discussed. Difficulties in its observation, due to interference from atmospheric luminescence, stellar and galactic light, and perturbations produced by atmospheric absorption and scattering are considered. In order to study zodiacal light, it must be separated from the other components of night sky. The steps of such a method are outlined. Although the method is difficult to apply and the corresponding mathematical formulation is complex, the results obtained are superior in quality to those of any previously used method. The astronomical observatory located at Teide and its associated photometric instruments for observing zodiacal light are described. Present day knowledge of zodiacal light, concerning the physical-chemical composition of the interplanetary material which causes this phenomenon, its spatial distribution, and its evolution, are discussed. Transl. by R.N.A.

N68-24497*# California Univ., Berkeley. Space Sciences Lab.
A NEW METHOD OF MAGNETOGRAPH OBSERVATION OF THE PHOTOSPHERIC BRIGHTNESS, VELOCITY, AND MAGNETIC FIELDS
Robert Howard, Andrew S. Tanenbaum, and John M. Wilcox 30 Jan. 1968 34 p refs *Its* Ser. No. 9, Issue No. 7
(Grants NGR-05-003-230; NsG-243; Contract Nonr-3656(26); Grant NsF GA-1319; ONR Proj. NR-021-101)
(NASA-CR-94674) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Several improvements have been made to the Mt. Wilson Observatory solar magnetograph, including changes to the guider,

the Doppler compensator, and the data handling system. The improved magnetograph has been used for a new type of solar observation consisting of several hundred scans back and forth along a straight line of length 3/4 R_o perpendicular to central meridian. The data reduction, which is done entirely with a computer, eliminates those effects which have their origin in the earth-sun geometry. The spatial and temporal properties of the 5-minute oscillations are discussed. Author

N68-24531# Joint Publications Research Service, Washington, D. C.
ASTRONOMY
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 180 22 May 1968 p 1-8 refs (See N68-24530 14-13)

Scientific articles on astronomy taken from the Soviet-bloc open literature are abstracted, and some news items are included. The latter presents a review of comparative planetology, and discusses a handbook on astronomy and cosmonautics. Observations of 560 radio sources at 86 Mc/sec are reported as are some data on flare stars. Abstracts deal with lunar craters, Fraunhofer lines in the solar spectrum, stellar content, the Venusian atmosphere, and a meteor model of a zodiacal cloud. Evolution of the isotopic composition of lead is discussed, as the calibration of a solar magnetograph. M.W.R.

N68-24557*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LANDING SITE DISPERSIONS OF AN UNCONTROLLED LANDER ON MARS
John S. White Washington May 1968 24 p refs
(NASA-TN-D-4587) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A study was made to determine the accuracy with which a lander, descending from a bus orbit, can reach a specified landing site on Mars without using a range control system. This report considers both a lifting and a nonlifting lander—each with two different values of mass. Several different entry angles were considered, along with two different procedures for the deorbit maneuver: the use of the minimum deorbit velocity increment and the use of a constant deorbit velocity increment. The error sources considered are variations in the Martian atmosphere, variations in the actual lift of the vehicle, and errors in performing the deorbit maneuver. It is concluded that if minimum deorbit velocity increment is used with entry angles of $-20°$ to $-24°$, the landing site accuracy will be on the order of 1°, which is of the same order as the present knowledge of the location of the landing site. Thus a range control system need not be included in the lander. Author

N68-24575*# Martin Co., Denver, Colo.
TECHNICAL DATA AAP MISSION 1A 60-DAY STUDY
20 Sep. 1967 252 p
(Contract NAS8-21004)
(NASA-CR-61785; PR-29-82) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The purpose of the study was to define a hardware configuration and to develop an approach for integrating 23 experiments into the Apollo Applications Program mission 1A (AAA-1A). The objectives of the experiment complement and mission operations are: (1) to evaluate operational feasibility of selected earth-resources, bioscientific, meteorology, and astronomy experiments; (2) to verify the enhancement of experiments by the presence of man for monitoring, controlling, and interpreting data; (3) to obtain operating experience on available hardware; and (4) to extend experiment coverage to 50 degrees latitude. The major tasks accomplished are: (1) definition of experiment requirements, availability, and hardware configurations developed from trade studies within established ground rules; (2) preparation of mission timelines, supporting criteria, crew integration criteria, trade studies, and analyses for optimal fulfillment of experiment and subsystem support requirements; (3) development of approaches to procure, manufacture, integrate, test, and operate the experiments, supporting structure, and subsystems; and (4) coordination of studies, and evaluation of interfaces with the Command Service Module and Kennedy Space Center operations. The results of the study show that the mission objectives can be met. K.W.

N68-24578*# Martin Co., Denver, Colo.
COMPILATION OF TRADE STUDIES, ENGINEERING ANALYSES AND OTHER REPORTS PREPARED DURING AAP MISSION 1A 60-DAY STUDY, PART 3
20 Sep. 1967 333 p refs
(Contract NAS8-21004)
(NASA-CR-61791; PR-29-83, Pt. 3) CFSTI: $3.00 CSCL 22C

Presented are 10 reports with diagrams, graphs, and drawings constituting support data to the final report. Covered are: (1) final systems safety; (2) thermal control systems and pump selection studies; (3) pointing and stability studies; (4) PCM encoder review, tape recorder, and data bandwidth utilization; (5) carrier timing techniques; and (6) experiment requirements. K.W.

N68-24579*# Martin Co., Denver, Colo.
COMPILATION OF TRADE STUDIES, ENGINEERING ANALYSES AND OTHER REPORTS PREPARED DURING AAP MISSION 1A 60-DAY STUDY, PART 1
20 Sep. 1967 374 p refs
(Contract NAS8-21004)
(NASA-CR-61788; PR-29-83, Pt. 1) CFSTI: $3.00 CSCL 22C

Presented are 22 reports with diagrams, graphs, and drawings constituting support data to the final report. Covered are: (1) optimum orbit inclination, comparison of launch times for best mission operation, 24-hour sample timeliness, and spacecraft orientation; (2) on-pad accessibility study; (3) coolant selection and thermal radiator analysis; (4) carrier configuration and pressurization studies; (5) non-metallic material selection criteria and guidelines; (6) studies on crew worksite, Command Module (CM) window visibility and viewfinder, modular mission, contingency planning, crew equipment, carrier illumination, and CM storage management; (7) simulation and training/trainer requirements; (8) electrical power, fuel cells vs. batteries, and power profiles; and (9) logistics support criteria, revised ground track, network and truth site data, and ground servicing equipment. K.W.

N68-24580*# Martin Co., Denver, Colo.
COMPILATION OF TRADE STUDIES, ENGINEERING ANALYSES AND OTHER REPORTS PREPARED DURING AAP MISSION 1A 60-DAY STUDY, PART 2
20 Sep. 1967 363 p
(Contract NAS8-21004)
(NASA-CR-61790; PR-29-83, Pt. 2) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Presented are 18 reports with diagrams, graphs, and drawings constituting support data to the final report. Covered are: (1) meteoroid vulnerability of the Mission 1A carrier pressure shell and radiators; (2) cold plate thermal study; (3) stress analysis; (4) flight article and ground support equipment acceptance; (5) support camera selection, experiment S019 and S020 film extraction, scientific airlock, and scientific experiment modifications and locations; (6) display and control studies; (7) maintainability and reliability predictions and mass properties report; (8) structural configuration and installation of experiments and subsystems; and (9) kennedy Space Center ground operations plan, ground checkout systems, and 1A carrier handling, access, and transportation. K.W.

N68-24637*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE BIBLIOGRAPHY
Jan. 1968 64 p refs Compiled for NASA by Natl. Aerospace Education Council, Washington, D. C. 4th Edition
(NASA-EP-48) GPO: HC$0.40; CFSTI: MF$0.65 CSCL 22A

Presented is a selected, annotated, graded and updated bibliography of books, reference works, periodicals, and teaching aids dealing with space flight subjects. The bibliography is intended for elementary and secondary school teachers, pupils, and the general adult reader. The books bear copyright dates 1965 through 1967. K.W.

N68-24644*# Arizona Univ., Tucson. Steward Observatory.
IRIS PHOTOMETRY ON SMALL SCALE PLATES
W. G. Tifft Jul. 1967 19 p refs
(Grant NsG-732)
(NASA-CR-94707; T-67-10) CFSTI: HC $3.00/MF $0.65 CSCL 03A

A series of measurements were conducted to determine the precision obtainable in normal iris photometry of stars on very small scale direct sky photographs. Tabulations are included to show the basic data on the four plates and the several comparison plates used; the list of stars, their adopted V and B magnitudes, the iris readings for each F/1 camera plate, and references to the sources of the V and B photometry; and the quantitative results for magnitude residuals as a function of class in the iris range indicated. It was generally concluded: (1) Iris photometry is a valid means of photographic photometry on plates of all scales from the wide-field fast Schmidt to the large scale reflector in a small detailed field. (2) Except near the plate limit, iris photometry intrinsic accuracy is about 1% to 3% for large scale telescope plates. (3) Errors from slight variations in centering on images is less than intrinsic plate errors. (4) Unresolved background and close companions will effect the photometry appreciably; however, the effects are visually apparent and isolated stars can be readily distinguished for photometry. M.G.J.

N68-24652# Joint Publications Research Service, Washington, D. C.
ASTROMETRICAL STUDIES ON REFERENCE STARS, CATALOG ERRORS AND STELLAR INSTRUMENTATION
M. S. Zverev et al 22 May 1968 20 p refs Transl. into ENGLISH from the book "Trudy 17-Y Astrometricheskoy Konferentsii SSSR" Leningrad, Sci. Publishing House, 1967 p 1–235
(JPRS-45452) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. PRESSING PROBLEMS OF ASTROMETRY M. S. Zverev p 1–8 (See N68-24653 14-30)
2. ERRORS IN GC CATALOG FOR EPOCH 1960.0 A. S. Kharin p 8–13 refs (See N68-24654 14-30)
3. LARGE TRANSIT INSTRUMENT FOR OBSERVATIONS OF SOUTHERN HEMISPHERE STARS A. A. Nemiro and Yu. S. Streletskiy p 13–19 refs (See N68-24655 14-14)

N68-24653# Joint Publications Research Service, Washington, D. C.
PRESSING PROBLEMS OF ASTROMETRY
M. S. Zverev *In its* Astrometrical Studies on Reference Stars, Catalog Errors and Stellar Instrumentation 22 May 1968 p 1–8 (See N68-24652 14-30)

Compilation of a catalog of weak reference stars is considered the most pressing problem for Soviet astrometry, and it is noted that such a need was first suggested 34 years ago and that studies were begun 27 years ago. A catalog has not been prepared because the orientation of a system of coordinates of the stellar catalog that is based on observations of the minor planets has not been evolved. Further, the absolute motions of the stars of the various galaxies have not been derived. Studies currently underway in the Soviet Union are concerned with photographic astrometry, rotation of the earth, shape of the moon, and application of precise observations of the moon for astronomy and geodesy. M.W.R.

N68-24654# Joint Publications Research Service, Washington, D. C.
ERRORS IN GC CATALOG FOR EPOCH 1960.0
A. S. Kharin *In its* Astrometrical Studies on Reference Stars, Catalog Errors and Stellar Instrumentation 22 May 1968 p 8–13 refs (See N68-24652 14-30)

When latitude observations of 17 systems of declination were compared with declinations obtained from a catalog of stars, 13 of the systems were composed entirely of stars from the GC catalog. Differences of star types are tabulated for four large programs for the epoch 1960.0, and curves are plotted for each of these programs with 64 stars in each case. Variations in errors in the GC catalog during the transition from one group of stars to another appears to cause differences in the curves. It is concluded that the random errors in the declinations of the GC catalog for the epoch 1960.0 became so high the systematic errors could not even be observed in comparisons with the catalogs with 150 to 200 stars. M.W.R.

N68-24721# General Electric Co., Philadelphia, Pa. Missile and Space Div.
GENERAL ELECTRIC RECONTAMINATION MODEL
G. L. Meyer 20 Sep. 1967 24 p
(Doc.-67SD313)

The probability of planetary quarantine violation via recontamination of the planetary lander is derived. In addition to the more general model, a useful approximation to it is also presented. Author

N68-24730*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
PRELIMINARY RESULTS OF VENUS OBSERVATIONS BETWEEN 8 AND 13 μ
R. Hanel, M. Forman, T. Meilleur (Consultants and Designers, Inc.), and G. Stambach May 1968 21 p refs
(NASA-TM-X-63217; X-620-68-200) CFSTI: HC $3.00/MF $0.65 CSCL 03A

The emission spectrum of Venus has been observed between 750 cm $^{-1}$ and 1250 cm $^{-1}$ from the 61 inch Harvard Observatory telescope using a Michelson interferometer capable of resolving one wavenumber. A preliminary analysis confirms a broad absorption-like feature near 890 cm $^{-1}$ but evidence of the 960 and 1060 cm $^{-1}$ CO_2 bands is weak if observable at all. The 791 cm $^{-1}$ CO_2 Q branch seems to be stronger in the Venus spectra than in the lunar comparison spectrum. The measured brightness temperature of about 250°K is slightly higher than most previous estimates. Author

N68-24733*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
SATELLITE OBSERVATIONS OF RADIO NOISE IN THE MAGNETOSPHERE
S. J. Bauer and R. G. Stone May 1968 11 p refs
(NASA-TM-X-63216; X-615-68-185) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Noise bands at medium frequencies appear to originate from energetic particle interactions with the thermal plasma. Their cutoffs are determined by magneto-ionic parameters of the medium and can be used to determine local plasma density. Author

N68-24782# Royal Aircraft Establishment, Farnborough (England).
REACTION WHEEL SYSTEMS FOR COARSE AND FINE STAR-REFERENCED ATTITUDE CONTROL OF A STELLAR OBSERVATORY SATELLITE
W. G. Hughes and G. J. Davison Mar. 1967 91 p refs
(RAE-TR-67056) CFSTI: HC $3.00/MF $0.65

This study was made with a view to application in the ESRO Large Astronomical Satellite carrying the British scientific payload proposal. Stellar ultra-violet spectra are to be measured with a resolution of 0.1 Å, requiring fine stabilization relative to the observed star with an error not exceeding 0.1 arc sec. A single design of reaction wheel is used both for this fine control and for the coarse control to permanent star references, the latter providing initial alignment of the observational telescope with an overall error not exceeding 2 arc min. Taking account of environmental and operational conditions, practical details of star sensors and reaction wheels, inter-axis couplings and fine control acquisition problems, it is concluded that the objectives can be achieved, as long as the observed star is not fainter than magnitude 9 or 10. Author

N68-24799# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.
INVESTIGATIONS ON THE PERTURBATIONS OF 24H-TRAJECTORIES DUE TO LUNAR GRAVITATION AND EARTH'S TRIAXIALITY BY MEANS OF THE FEHLBERG METHOD OF INTEGRATION [UNTERSUCHUNGEN UEBER DIE STOERUNGEN VON 24H-BAHNEN DURCH DEN MOND UND DIE TRIAXIALITAET DET ERDE MIT HILFE DES FEHLBERGSCHEN INTEGRATIONSVERFAHRENS]
Fromut Henschel Mar. 1968 44 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-13) CFSTI: HC $3.00/MF $0.65

The perturbations of a 24 h satellite due to lunar gravitation and Earth's triaxiality are investigated, specially including the inclination of the equator against the ecliptic. First an intermediate periodic solution is calculated neglecting the ellipticity of the equator and the inclination of the equator. The numerical integrations are performed by the method of Fehlberg with automatic step size control. Author

N68-24809 Maryland Univ., College Park.
TWENTY-ONE-CM LINE OBSERVATIONS OF SMALL DIAMETER GALACTIC H 2 REGIONS
Kurt Wetherhold Riegel (Ph.D. Thesis) 1966 69 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-2395

Twenty-seven Galactic H II regions have been observed in the 21-cm spectral line using the 300-foot transit radio telescope and the 100 channel digital autocorrelator of the National Radio Astronomy Observatory. Neutral hydrogen components associated with IC 5146, NGC 281, S170, and S222 have been detected. IC 5146 has an H I mass of 670 $M_\odot$ and an H II mass of 20 $M_\odot$, and is not a simple isolated gravitationally bound system. NGC 281 has an H I mass of at least 16,000 $M_\odot$, and an H II mass of 880 $M_\odot$, and has a 21-cm systemic velocity in perfect agreement with the optical value. IC 5146 and NGC 281 both contain star clusters, and all four objects with H I associated with them have patches of obscuration crossing them. There is no observational evidence for the existence of an expanding H I component containing an appreciable fraction of the observed neutral hydrogen mass in any of the cases reported. Seven high latitude H II regions have no neutral hydrogen associated to an upper limit of 8°K brightness temperature. The sixteen remaining H II regions either had no clear H I features visible above the large scale background, or were located in regions so complex as to make detection impossible. Dissert. Abstr.

N68-24820*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
SPACE AND TIME VARIATIONS IN THE LIGHT INTENSITY OF THE TWILIGHT SKY [PROSTRANSTVENNYYE I VREMENNYYE VARIATSII INTENSIVNOSTI SVECHENIYA SUMERECHNOGO NEBA]
T. G. Megrelishvili, T. I. Toroshelidze, and I. A. Khvostikov Washington NASA May 1968 35 p refs Transl. into ENGLISH from Bull. of the Abastumani Astrophys. Obs., no. 34, 1966 p 63-94
(Contract NASw-1692)
(NASA-TT-F-11572) CFSTI: HC $3.00/MF $0.65 CSCL 03A

A survey is presented on systematic measurements of the twilight sky made in various portions of the spectrum. General characteristics of the twilight sky are given based on photometric and spectrophotometric observations. A detailed analysis is made of the spectral distribution of the brightness of the twilight sky as a function of the solar zenith distance in various seasons. Intensity variations of individual lines of the twilight glow in the atmosphere are also discussed. B.S.D.

N68-24846# Madrid Univ. (Spain). Facultad de Ciencias.
PHOTOMETRIC DETERMINATION OF THE GREEN LINE AND THE ATMOSPHERIC CONTINUUM AT TEIDE OBSERVATORY, TENERIFE, JANUARY 1964 TO JULY 1965 [FOTOMETRIA ABSOLUTA DE LA RAYA VERDE Y DEL CONTINUO ATMOSFERICOS EN EL OBSERVATORIO ASTRONOMICO DEL TEIDE (TENERIFE), DE ENERO DE 1964 A JULIO DE 1965]
F. Sanchez Martinez and R. Dumont 1967 21 p refs In SPANISH; ENGLISH summary Submitted for publication
(Publ.-60) CFSTI: HC $3.00/MF $0.65

The zenith brightness of the green oxygen line and λ of the atmospheric continuum were computed from 364 photoelectric measurements of the polar values of the 5577 Å and 5000 Å brightnesses of the night sky. The two radiations are fairly correlated in brightness, and both show a tendency to a maximum near local midnight. Author

N68-24855*# Consultants and Designers, Inc., Arlington, Va.
FIRST PANORAMAS OF THE LUNAR SURFACE ACCORDING TO THE MATERIAL FROM THE AUTOMATIC STATION LUNA-9 [PERVVYE PANORAMY LUNNOY POVERKHNOSTI PO MATERIALAM AVTOMATICHESKOV STANTSII LUNA-9]
29 Jun. 1966 132 p Transl. into ENGLISH from Russian
(Contract NAS5-9299)
(NASA-CR-94656; ST-LPS-10503/SP) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Panoramic photographs and preliminary results of their evaluation are presented. Construction and equipment of the lunar vehicle are described as well as flight trajectory and control. The structure of the landing site and morphological peculiarities of the lunar surface are examined in detail. A topographic plan and a sketch of the landing site are included. K.W.

N68-24948# Fordham Univ., New York. Astronomical Lab.
TEN NEW IRREGULAR RED VARIABLE STARS IN THE CYGNUS CLOUD, VV 181-190
Walter J. Miller Vatican City Specola Vaticana 1967 22 p Rich. Astron., v. 7, no. 7
CFSTI: HC $3.00/MF $0.65

Photometric data are reported for ten irregular red variables (including one BD star), with maxima ranging from the tenth to the fifteenth photographic magnitudes. The study of these stars was based on a total of 7,559 Vatican, Hamburg, Heidelberg, Harvard and Mount Wilson and Palomar Observatory plates. The results are tabulated, and fragmentary light curves for all ten variable stars are presented. Author

N68-24972# Specola Vaticana (Vatican City).
ASTROMETRIC PROGRAMME FOR IBM 1620. POSITIONS OF 120 LATE TYPE STARS IN THE REGION OF THE PLEIADES
F. C. Bertiau and E. de Graeve 1967 32 p refs *Its* Rich. Astronomiche, v. 7, no. 8–9
CFSTI: HC $3.00/MF $0.65

Equatorial coordinates for any number of stars are derived from rectangular coordinates measured on a photographic plate. At least 6 reference stars are necessary. The neighborhood of the equatorial pole does not affect the precision of the results. Although the program was chiefly written to obtain positions for identification purposes, it can be easily expanded to obtain positions of high precision. Author

N68-25008*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER-MARS INERTIAL PROPERTIES DETERMINATION AND MIDCOURSE MOTOR ALIGNMENT
W. W. Hough and J. D. Schmuecker 15 May 1968 36 p
(Contract NAS7-100)
(NASA-CR-94666; JPL-TR-32-852) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The mass of a spacecraft whose mission requires a precise trajectory must be accurately known for booster performance calculations and for burn-time calculations associated with on-board rocket engine firings. The position of the center of gravity (cg) of a spacecraft must be accurately known so that the thrust vector of the onboard propulsion system may be aligned to eliminate offset torques during motor firing. If perfect alignment of the thrust vector to the cg is not accomplished, maneuver events may be modified to correct for the misalignment, but only if the misalignment is known. The application of these requirements to the Mariner Mars 1964 fly by mission is reported. The method of analytically and experimentally determining the weight and cg of Mariner Mars and of positioning its midcourse motor are discussed in detail. Particular attention is paid to the method of vernier adjustments on maneuver turns to account for known misalignment of the nominal thrust vector to the cg. The effect of the tolerances involved in weight and cg measurement and in motor positioning on total midcourse maneuver accuracy is also discussed. Author

N68-25012*# Aeronutronic, Newport Beach, Calif.
EXPERIMENTAL INVESTIGATION OF THE ABSORPTION BY VARIOUS GASES OF PLANETARY INTEREST Final Technical Report
David A. Gryvnak and Darrell E. Burch 29 Apr. 1968 18 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951712)
(NASA-CR-94787; U-4367) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Spectral curves of transmission have been obtained in regions near 1.6 μ and 2.3 μ with approximately 0.3 cm^{-1} resolution for the following gases at 196°K: CH_4, CH_3Cl, CH_3F, CH_2F_2, CH_2ClF, CHF_3, $CHClF_2$, $CHCl_2F$, and C_2H_6. Sample pressures varied between 2.0 and 2.5 torr with 32.9 meter path length. Path lengths up to more than 1 kilometer have also been used to study absorption by weak CO_2 bands from 4225 to 4540 and from 1140 to 1800 cm^{-1}. In the higher wavenumber interval most of the absorption is due to the 0710 band of $C^{12}O^{16}O^{16}$, the 00°2 band of $C^{13}O^{16}O^{18}$, and the 16°0—01¹0 band of $C^{12}O^{18}_2$. The 10°0 and 02°0 bands of $C^{12}O^{16}_2$ and $C^{12}O^{16}O^{18}$ contribute most of the absorption in the 1140–1800 cm^{-1} interval. In this interval the absorption by the symmetric $C^{12}O^{18}_2$ molecule is pressure induced. Author

N68-25045*# Southwest Center for Advanced Studies, Dallas, Tex.
THE ATMOSPHERE OF VENUS: A CONFERENCE REVIEW
Francis S. Johnson Apr. 1968 16 p refs
(Grant NsG-269)
(NASA-CR-94774) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Data from Mariner 5, the Soviet planetary probe Venera 4, and recent ground-based measurements have provided much new information and permitted a great step forward in our knowledge of Venus. Although the data from the various sources generally complement one another very well to provide a fairly detailed picture of the atmosphere of Venus, several serious discrepancies exist that still require clarification. These relate to composition—particularly oxygen and water—and the surface pressure and temperature. On the positive side, it is now clear that the atmosphere is very dry, with great pressure and high temperature surface. It also appears increasingly probable that the greenhouse theory can account for the very high surface temperature. The most likely explanation for the clouds is that they are of convective type consisting of ice crystals and with tops near the 0.2 atm pressure level. Author

N68-25072# Fordham Univ., New York. Astronomical Lab.
TEN NEW VARIABLE STARS IN THE CYGNUS CLOUD, VV 200
Walter J. Miller Vatican City Specola Vaticana 1967 23 p Rich. Astronomiche, v. 7, no. 10
CFSTI: HC $3.00/MF $0.65

Photometric data are given for one Algol eclipsing variable and for nine long period variable stars. The study was based on a total of 4024 Vatican, Hamburg, Heidelberg, Harvard, Mount Wilson, and Palomar Observatory plates. The results are summarized in five tables and five pages of light curves. An appended table gives a finding list for the first two hundred Vatican Variable stars, arranged in order of increasing right ascension. Author

N68-25073# Fordham Univ., New York. Astronomical Lab.
NINE CYGNUS CLOUD VARIABLE STARS, VV 172–180
Walter J. Miller Vatican City Specola Vaticana 1967 21 p refs Rich. Astronomiche, v. 7, no. 6
CFSTI: HC $3.00/MF $0.65

Photometric data are reported for one new Algol eclipsing variable, for three new long period variables, for one new variable of unknown type with a single well-observed maximum, for one irregular red variable (previously designated as an eclipsing variable), for one already-known long period variable, for a variable with a nova-like spectrum, and for a reputed slow nova. The study of the nine stars was based on a total of 12,046 Vatican, Hamburg, Heidelberg, Harvard, Mount Wilson and Palomar Observatory plates at Fordham University. The results are summarized in several tables, and either mean or fragmentary light curves are presented for all nine variables. Author

N68-25148*# Volt Technical Corp., Washington, D. C.
INVESTIGATION OF VENUS' BACKSCATTERING DIAGRAM AT 40 CM [ISSLEDOVANIYE DIAGRAMMY OBRATNOGO RASSEYANIYA VENERY NA VOLNE 40 CM]
Yu. N. Aleksandrov, B. I. Kuznetsov, and O. N. Rzhiga Greenbelt, Md. NASA. Goddard Space Flight Center 29 May 1968 9 p refs Transl. into ENGLISH from Atron. Zh. (Moscow), v. 45, no. 2, 1968 p 371–377
(Contract NAS5-12487)
(NASA-CR-94770; ST-LPS-RA-10720) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The diagram of Venus backscattering in the wavelength of 40 cm is determined by two methods: by Doppler spectrum and by the range of energy distribution of reflected signals. Within the limits of precision linked with the limited resolution of the initial spectrum, both methods gave identical results. The Doppler spectrum and the range distribution of signals reflected by Venus are in good agreement with the theoretical dependences computed

in the assumption that the bulk of radiowave energy is specularly reflected, and that the spatial altitude correlation on the surface of Venus is defined by an exponential function. The Gauss function gives no coincidence. A certain part of energy is diffusively scattered by elements of the surface, whose dimensions are commensurate with the wavelength. The smoothness factor of the diffusively scattering surface is comprised between 0 and 1. Author

N68-25155# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.

ANALYSIS OF THE MOTION OF A MASS POINT IN A CENTRAL FORCE FIELD UNDER INFLUENCE OF TANGENTIAL THRUST WITH APPLICATION OF BALLISTIC ENTRY INTO EARTH ATMOSPHERE [THEORIE DER BEWEGUNG EINES MOBILS IM ZENTRALKRAFTFELD BEI TANGENTIALSCHUB MIT ANWENDUNG AUF DEN BALLISTISCHEN EINTRITT IN DIE ATMOSPHAERE]

Ernst August Bockemueller Feb. 1968 61 p refs In GERMAN; ENGLISH summary

(DLR-FB-68-12) CFSTI: HC $3.00/MF $0.65

An analysis is made of the motion of a mass point in a central force field under the action of tangential thrust. A relationship between the inclination angle of the trajectory and the velocity, both considered as functions of the altitude, is obtained, which is explicitly independent of the thrust function. With this statements on the local behavior of the trajectories may be obtained. With the assumption that the velocity slowly varies with altitude, approximate formulae are derived for the inclination angle, range, and time history. The results of the analysis are used to investigate the ballistic entry into the Earth's atmosphere. An analytical treatment of the intermediate phase is performed, where the aerodynamic deceleration and the gravitational acceleration are of the same order of magnitude. A relation for the inclination angle is derived and the corresponding region of validity is determined as a function of accuracy, initial values, and vehicle constants. Author

N68-25183*# Volt Technical Corp., Washington, D. C.

DETERMINATION OF THE PHOTOGRAPHIC POSITION OF AN OBJECT WITH THE AID OF TWO AND THREE REFERENCE STARS

A. N. Deych Greenbelt, Md. NASA. Goddard Space Flight Center 22 May 1968 19 p refs Transl. into ENGLISH from Astron. Zh. (Moscow), v. 25, no. 2 p 44–58

(Contract NAS5-12487)

(NASA-CR-94783; ST-OA-CM-10712) CFSTI: HC $3.00/MF $0.65 CSCL 03A

In this article formulas are derived for determining the position of a celestial object on the basis of two reference stars given by equatorial coordinates. In this connection, second-order terms are taken into account which are derived for a $5^\circ \times 5^\circ$ field with an error not greater than 1 sec. Analysis of third-order terms shows that such terms can be discarded for the same limitations and for declinations not greater than 60°. If the object being determined is located close to the optical center the precision of formulas is increased tenfold. The method described here can be easily extended to the case of three reference stars whereupon in this case all terms with the coefficient b_1 vanish, which may significantly increase the precision of determination of object's position. Tables are given at the end of the paper for a rapid accounting of second-order terms. Author

N68-25223# Lund Observatory (Sweden).

THE COLOUR-MAGNITUDE DISTRIBUTION OF GIANT STARS AS A FUNCTION OF AGE

Ulf Lindoff Stockholm Almqvist and Wiksell 1968 21 p refs Arkiv Foer Astron., v. 5, no. 2

CFSTI: HC $3.00/MF $0.65

By means of the yellow and red giants, that are possible members of open clusters, the colour-magnitude diagram is studied as a function of age. To provide adequate statistical material the clusters are combined into 11 age groups. The regions in the colour-magnitude diagram, where the observed giants are concentrated, are in general situated lower than demanded by stellar evaluation computations. From the number of giants and the number of stars on the upper main sequence the giant lifetimes are estimated for various masses. The time intervals obtained are much lower, down to about 15 percent of those indicated by the model computations. The various sources of error inherent in the comparison of observation with theory are discussed. Author

N68-25224# California Univ., Livermore. Lawrence Radiation Lab.

GRAVITATIONAL COLLAPSE OF A NEUTRON STAR [COLLASSO GRAVITAZIONALE DI UNI STELLA A NEUTRONI]

Jul. 1966 25 p refs Transl. into ENGLISH of Rome Univ., Italy, Internal Rept. No. 66/4, May 1966

(UCRL-TRANS-10206) CFSTI: HC $3.00/MF $0.65

A numerical method was studied to integrate the system of partial differential equations which determines the evolution of a perfect fluid in general relativity. The method was used to calculate the evolution of a neutron star with a mass greater than $0.7 M_\odot$ in the neighborhood of its Schwarzschild singularity. Author (NSA)

N68-25262# Lund Observatory (Sweden).

THE OPEN CLUSTERS NGC 2483 AND NGC 2489

Ulf Lindoff and Kjell Johansson Stockholm Almqvist and Wiksell 1968 17 p refs Arkiv foer Astron, v. 5, no. 3

CFSTI: HC $3.00/MF $0.65

Photographic magnitudes on the UBV system based on photoelectric sequences were determined for stars in the open clusters NGC 2483 and NGC 2489. For the brightest stars, spectral classes were obtained from objective prism plates. NGC 2483 was rediscovered, and is probably a real star cluster. The B–V color excess is determined to $0^m.42$ for NGC 2483 and to $0^m.40$ for NGC 2489. The distances are 3300 pcs and 1200 pcs, respectively. NGC 2483 is a very young cluster; NGC 2489 is rather old. Author

N68-25271*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SPACE TRAJECTORIES AND ERRORS IN TIME, FREQUENCY, AND TRACKING STATION LOCATION

F. O. Vonbun Washington Jun. 1968 22 p refs

(NASA-TN-D-4507; NASA-TM-X-55798) CFSTI: HC $3.00/MF $0.65 CSCL 09F

This paper demonstrates analytically how errors in tracking station time and frequency synchronization, as well as errors in station location, influence the accuracy of trajectory determination. Two systems, whose data are presently used for most of the more accurate orbit determination schemes, are described: a range and range rate system, and a radar system. All other systems are actually combinations of these two basic systems. Rather simple analytical expressions are derived relating measuring errors with those of time and frequency synchronization, as well as ground tracking station location. For the range and range rate system, the error in range rate $\delta\dot{r}$ is used as a yardstick, and all other quantities are derived from it. For the radar system (not measuring range rate directly), the total local position vector, as measured by such a system is used as the yardstick to determine the necessary time synchronization and station location accuracy. Numerical examples are presented. Author

N68-25310*# Volt Technical Corp., Washington, D. C.
ROTATION AND ORIENTATION OF COSMIC DUST PARTICLES [VRASHCHENIYE I ORIENTATSIYA KOSMICHESKIKH PYLINOK]
A. Z. Dolginov Greenbelt, Md. NASA. Goddard Space Flight Center 26 May 1968 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Astron. (Moscow), v. 179, no. 5, 1968 p 1070–1073
(Contract NAS5-12487)
(NASA-CR-94784; ST-ID-10718) CFSTI: HC $3.00/MF $0.65 C5CL 03B

Discussing the passage of light through the outer space medium, various hypotheses are invoked to find the causes inducing the spinning and orientation of cosmic dust particles. These phenomena are examined in interstellar, as well as interplanetary space. The roles of solar wind protons and of gas flows are discussed. The behavior of cosmic dust particles in planetary atmospheres is also examined. Author

N68-25329*# California Univ., Berkeley.
LUNAR STRATIGRAPHY AS REVEALED BY CRATER MORPHOLOGY, A CRITICAL REVIEW
F. E. Heuze Apr. 1968 19 p refs
(Grant NSR-05-003-189)
(NASA-CR-61219) CFSTI: HC $3.00/MF $0.65 CSCL 03B

An overview is presented on the various studies undertaken to determine the extent and thickness of the fragmental layer of fine grained materials which is believed to overlay a hard base composed of one or several layers of possible volcanic origin. Tabulated data are included on lunar craters morphology and lunar surface stratigraphy techniques. Four methods of determining surficial layer thickness are assessed: (1) comparative study of Ranger photographs, and laboratory simulation of the overlay deposition; (2) direct study of Orbiter and Surveyor photographs, based on the identification and measurements of block fields, terraces, and outcrops; (3) comparative study of Orbiter photographs applied to impact crater morphology; and (4) use of a mathematical model for time-dependent erosion of lunar craters. It is concluded that for final mission planning, at a given site, extensive high resolution photographic coverage is mandatory, and the interpretation should rely upon visual observation. M.G.J.

N68-25377 Texas Univ., Austin.
SOME RELATIVISTIC COSMOLOGICAL MODELS
Ronald Kantowski (Ph.D. Thesis) 1966 64 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-3306

This paper presents some relativistic cosmological models which are spatially homogeneous and anisotropic. There are two types of spatially homogeneous models. The first type can be characterized as those spatially homogeneous models which do not permit a simply transitive group of motions. In addition some models which are of the Taub-Heckmann-Schucking type are presented. The stress-energy tensor is taken to be that of a perfect fluid and solutions are presented for four different cases. The first two are for vanishing pressure, with and without a cosmological constant, i.e., dust models. The second two are for vanishing cosmological constant with the respective equations of state $p = 1/3\ \rho$ (photon gas) and $p = \rho$ (stiff matter). Dissert. Abstr.

N68-25385*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THEORY OF THE INVESTIGATION OF THE ATMOSPHERE OF BINARY STARS BY ANALOGY BETWEEN GAS DYNAMICS AND SHALLOW-WATER FLOWS
Ernst W. Adams and Burkhard Schulz-Jander (Deut. Versuchsanstalt fur Luft- und Raumfahrt, Freiburg, West Ger.) Washington Jun. 1968 22 p refs
(NASA-TN-D-4520) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Approximate solutions of the differential equations of continuum isentropic gas dynamics may be obtained for flows in the equatorial plane of a binary star atmosphere, by analogy between gas dynamics and shallow-water flows in a rotating water tank. The local inclination of the tank's bottom is proportional to the resulting local gravitational force at the corresponding point in the binary-star atmosphere. The analogy requires a constant polytropic coefficient of two. This application of the analogy rests on its extension to rotating systems with external force fields. A theoretical evaluation of the analogy (for the earth's atmosphere under hydrostatic conditions with polytropic coefficient equal to two) yields the correct "maximum" height of the atmosphere—where density reaches zero. This study is motivated by the possibility that it may be applied to the early stages of the evolution of the earth–moon system after its hypothetical fission. Author

N68-25409# Lund Observatory (Sweden).
INVESTIGATIONS OF OPEN CLUSTERS
Ulf Lindoff 1968 11 p refs *Its* Ser. 1, No. 231
CFSTI: HC $3.00/MF $0.65

Late-evolution sequences for stars of various masses were compared with color-magnitude distributions of yellow and red giant stars observed in open clusters. A number of clusters that were almost neglected previously were studied, and it was assumed that all the stars in a cluster are of approximately the same age. Giant members of clusters were studied as a function of age to permit conclusions on stellar evolution. All clusters with a Hertzsprung gap were used as long as studies could be made of the distribution of yellow and red giant stars in the color-magnitude diagram; and colors and magnitudes were measured on the UBV system, with spectral classes determined for the brightest stars in each cluster. M.W.R.

N68-25553*# IIT Research Inst., Chicago, Ill. Technology Center.
COMPOSITIONAL ANALYSIS OF LUNAR AND PLANETARY SURFACES USING NEUTRON CAPTURE GAMMA RAYS, 1 JANUARY–31 MARCH 1968
J. W. Mandler and R. A. Semmler Apr. 1968 37 p
(Contract NASr-65(18))
(NASA-CR-94773; IITRI-V6032-8) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The detection and quantitative determination of the presence of hydrogen is of prime concern to the capture gamma-ray experiment. The use of the hydrogenous neutron reflector has interfered with this measurement, due to the detection of hydrogen capture gamma rays produced in the reflector. A study was begun to determine how the detection of hydrogen could be accomplished without forfeiting the use of a neutron reflector. Results indicate that this can be done successfully if the crystal is shielded from the gamma rays produced in the neutron reflector. To accomplish this task, it is necessary to select a suitable material and shape for the fast neutron shield, to determine the neutron reflector thickness necessary to obtain good quality capture gamma-ray spectra, to determine the effect of a neutron reflector on the inelastic spectrum, and to decide whether shielding will be necessary to eliminate electromagnetic interferences. Author

N68-25582# Kiruna Geophysical Observatory (Sweden).
THE AGES OF OPEN CLUSTERS
Ulf Lindoff Stockholm Almqvist and Wiksell 1968 21 p refs *Its* Arkiv foer Astronomi, Vol. 5, No. 1; Medd. Fran Lunds Obs. Ser. 1, No. 227
CFSTI: HC $3.00/MF $0.65

A new method of determining the ages of open clusters is outlined. The relative number of stars in the upper part of the main sequence is taken into consideration and an age parameter, Γ, is introduced. The method is applied to 177 open clusters, for which the age parameter and the resulting ages are given in a catalogue. Comparisons are made with previous determinations of cluster ages. Author

N68-25583# Kiruna Geophysical Observatory (Sweden).
THE OPEN CLUSTERS NGC 2533, NGC 2567, NGC 2571, AND RU 58
Ulf Lindoff Stockholm Almqvist and Wiksell 1968 25 p refs *Its* Arkiv foer Astronomi, Vol. 4, No. 39; Medd. Fran Lunds Obs. Ser. 1, No. 223
CFSTI: HC $3.00/MF $0.65

Photographic magnitudes on the UBV-system and based on a photoelectric sequence have been determined for stars in the open clusters NGC 2533, NGC 2567, NGC 2571, and Ru 58. Spectral classes were obtained from objective prism plates for some of the brighter stars. The colour excess is 0.^m34 for NGC 2533, 0.^m72 for NGC 2567, and 0.^m32 for NGC 2571. The distances are 2800 pc, 1700 pc and 2050 pc, respectively. Ru 58 is probably no real cluster. In NGC 2533 a very red star ($(B-V)_0 \approx 3.5$) might be a physical member. Author

N68-25586*# Volt Technical Corp., Washington, D. C.
TEMPERATURE, PRESSURE AND DENSITY OF VENUS' ATMOSPHERE ACCORDING TO MEASUREMENT DATA OF THE AIS VENERA-4 [TEMPERATURA, DAVLENIYE I PLOTNOST' ATMOSFERY VENERY PO DANNYM IZMERENIY AVTOMATICHESMOY MEZHPLANETNOY STANTSII "VENERA-4"]
V. S. Avduyevskiy, N. F. Borodin, V. V. Kuznetsov, M. Ya. Marov et al Greenbelt, Md. NASA. Goddard Space Flight Center 8 May 1968 7 p Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Astron. (USSR), v. 179, no. 2, 1968 p 310–313
(Contract NAS5-12487)
(NASA-CR-94796; ST-LPS-PA-10708) CFSTI: HC $3.00/MF $0.65 CSCL 03B

This paper is a preliminary communication relative to the results of measurements obtained on AIS VENERA-4, relative to temperature, pressure and density of Venus' atmosphere. As such, this paper seems to be superseded by the more extensive communication verbally presented at the Second Arizona Conference on Planetary Atmospheres in March 1968. (ST-LPS-PA-10704 of 19 April). Since the mode of discussion, as well as some of the results differ from the above paper, cover-to-cover translation of this paper is presented. Author

N68-25590*# Volt Technical Corp., Washington, D. C.
DENSITY MEASUREMENT OF MOON'S SURFACE LAYER BY AUTOMATIC STATION "LUNA-13" [IZMERENIYE PLOTNOSTI POVERKHNOSTNOGO SLOYA LUNY AVTOMATICHESKOY STANTSIYEY "LUNA-13"]
A. A. Morozov, M. I. Smorodinov, V. V. Shvarev, and I. I. Cherkasov Greenbelt, Md. NASA. Goddard Space Flight Center 16 May 1968 6 p Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Tekhn. Fiz. (USSR), v. 179, no. 5, May 1968 p 1087–1090
(Contract NAS5-12487)
(NASA-CR-94797; ST-INS-LPS-10714) CFSTI: HC $3.00/MF $0.65 CSCL 22A

This paper describes the first direct experiment on the moon's surface density measurement using the radiometric method of registration of scattered γ-radiation. It is illustrated by a photograph of radiation densimeter's pickup unit and by a table showing the variation of the counting rate as a function of the relief of lunar surface immediately under specific parts of counters and of the source. Author

N68-25601*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-49, VOLUME 3 FOR THE PERIOD DECEMBER 1, 1967 TO JANUARY 30, 1968. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
29 Feb. 1968 381 p refs
(Contract NAS7-100)
(NASA-CR-94676; JPL-SPS-37-49, Vol. 3) CFSTI: HC $3.00/MF $0.65 CSCL 22

Updated data are presented on the various research projects being conducted on systems analysis, computation techniques, system design and integration, spacecraft power, guidance and control, engineering mechanics, materials, environmental simulation, aerodynamic facilities, telecommunications, and propulsion systems. Among the studies discussed are the following: (1) direct and indirect transfer Jupiter flyby trajectories for a solar electric spacecraft; (2) solar system data processing system; (3) discrete Bayesian estimation based on an orthogonal expansion; (4) computation of perturbations in rectangular coordinates; (5) design requirements and criteria for an entry and lander capsule; (6) experiments to define the fully developed wave phenomena associated with the destructive spinning mode of liquid rocket resonant combustion; (7) throttable propellant valve concept; (8) electronic improvements in the low field helium magnetometer; (9) combinatorial communications methods; and (10) data compression techniques. M.G.J.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N68-24368# National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.
FOUR BLACK BRANT 2 ROCKETS LAUNCHED AT CHURCHILL RESEARCH RANGE, MARCH 1965: AE-2-24, AD-2-52, AA-2-53, AA-2-60
A. Staniforth and D. H. O'Hara Jul. 1967 60 p refs
(ERB-715) CFSTI: $3.00

The engineering aspects associated with the launching of four scientific sounding rockets are described. Included is a description of payloads, the objectives of the experiments, the launching phase, and a discussion of the processed engineering data. The payload for AE-II-24 was fabricated for high altitude pressure measurements, and presented some unusual prelaunch problems in a requirement for continuous vacuum pumping until just before lift-off. Author

N68-24378# Royal Aircraft Establishment, Farnborough (England).
THE LONGITUDINAL AND LATERAL STABILITY OF A SPACECRAFT IN DECELERATING FLIGHT [DIE LAENGS UND SEITENSTABILITAET EINES FLUGKOERPERS BEI VERZOEGERTER BEWEGUNG]
H. M. Dathe Jan. 1968 29 p refs Transl. into ENGLISH from Z. Flugwiss. (Brunswick, W. Germany), v. 14, no. 5, 1966 p 235–242
(RAE-LIB-TRANS-1282) CFSTI: HC $3.00/MF $0.65

The effect of a violent deceleration along a flight path, as experienced by a spacecraft on reentry into the atmosphere, is taken into account in the equations of motion. The systems of equations of the longitudinal and lateral motions are solved by means of transformations of time. According to calculated examples for the short period and Dutch roll oscillation, the loss in stability due to deceleration, though smaller than one would expect from an approximation, cannot, however, be neglected in many cases. Author

N68-24473# General Electric Co., Philadelphia, Pa. Missile and Space Div.
ATTITUDE STABILITY OF SPHERICAL SATELLITE
D. G. Magiros and A. J. Dennison 21 Jul. 1967 11 p refs
(Rept.-67SD285)

The angular motion and its stability characteristics of a spherically shaped satellite, acted upon by aerodynamic and gravitational torques, are studied in this report. Conditions are found and regions are determined for the stability situation of the equilibrium positions of the motion of the satellite. Author

N68-24553*# Martin Co., Denver, Colo.
APOLLO APPLICATIONS PROGRAM (AAP) PAYLOAD INTEGRATION. GENERAL TEST PLAN, COMBINED MISSION, FLIGHTS AAP 1/2/3/4. VOLUME 1: TEST PROGRAM SUMMARY
7 Apr. 1967 135 p refs
(Contract NAS8-21004)
(NASA-CR-61789; ED-2002-49, V. 1) CFSTI: $3.00 CSCL 22B

This volume establishes overall test program guidelines for the Apollo Applications Program (AAP) Combined Mission, Flights AAP 1/2/3/4. Procedures for AAP hardware testing, from design concept through launch and postflight checks and analyses, are established and delineated. All testing aspects are described as they will occur during design, development, qualification, and operations phases, from subsystem component level to complete integration of facility, ground support equipment, and the vehicle for a launch operation. Criteria or ground rules adhered to in the preparation of the test plans are defined for payload integration testing of the qualification and flight article hardware at all locations and at all levels of equipment complexity. The principal locations affected by this plan are: the manufacturing sources of flight equipment; the Payload Integration Facility or equivalent space for Marshall Space Flight Center operations; and the Manned Space Operations Building and launch complex at Kennedy Space Center (KSC). K.W.

N68-24554*# Martin Co., Denver, Colo.
APOLLO APPLICATIONS PROGRAM (AAP) PAYLOAD INTEGRATION: GENERAL TEST PLAN COMBINED MISSION, FLIGHTS AAP 1/2/3/4. VOLUME 2: SUBSYSTEM DEVELOPMENT AND QUALIFICATION PLAN
7 Apr. 1967 44 p
(Contract NAS8-21004)
(NASA-CR-61787; ED-2002-49, V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 22B

This plan establishes test requirements and recommends certain tests for the development, qualification, and acceptance of new and modified components and subsystems of Apollo Applications Program (AAP) spacecraft modules which are a Marshall Space Flight Center responsibility. The plan serves as a guide for detailed test planning and applies to the following Combined Mission spacecraft modules: Flight AAP 1—Lunar Mapping and Synoptic Survey Rack; Flight AAP 2—S-IVB Stage Instrument Unit; Flight AAP 3—Resupply Module; and Flight AAP 4—Lunar Module, Ascent Stage, Apollo Telescope Mount Rack. Where tests are recommended, the following supplemental information is provided: gross descriptions of the tests; major test equipment identification; and recommended number of test articles. Ground support equipment test requirements are also covered. K.W.

N68-24576*# Martin Co., Denver, Colo.
APOLLO APPLICATIONS PROGRAM (AAP) PAYLOAD INTEGRATION. GENERAL TEST PLAN, COMBINED MISSION, FLIGHTS AAP 1/2/3/4. VOLUME 4: INTEGRATION AND PRELAUNCH CHECKOUT PLAN
7 Apr. 1967 349 p refs
(Contract NAS8-21004)
(NASA-CR-61784; ED-2002-49, V. 4) CFSTI: HC $3.00/MF $0.65 CSCL 22B

In this volume, the test requirements for the flight hardware of Apollo Applications Program (AAP) flights AAP 1 through AAP 4 are defined. Only the technical test requirements and recommended methods of satisfying these requirements are presented. In addition to the integration and prelaunch checkout requirements for these flights, the experiment test requirements for each of the flights are covered. Also included are instructions for the Apollo Telescope Mount/Rack Pointing Control System checkout. A brief description of the flight hardware and of the interfaces is given for each of the flights and for the two experiment checkouts. Test operations at the Marshall Space Flight Center and/or the Kennedy Space Center are presented in the form of time-based functional flows, functional flow diagrams, and requirement sheets. K.W.

N68-24577*# Martin Co., Denver, Colo.
APOLLO APPLICATIONS PROGRAM (AAP) PAYLOAD INTEGRATION: GENERAL TEST PLAN COMBINED MISSION, FLIGHTS AAP 1/2/3/4. VOLUME 3: PAYLOAD INTEGRATION DEVELOPMENT PLAN
7 Apr. 1967 417 p
(Contract NAS8-21004)
(NASA-CR-61786; ED-2002-49, V. 3) CFSTI: HC $3.00/MF $0.65 CSCL 22B

This plan defines Apollo Applications Program (AAP) integrated module development and qualification test programs for which Marshall Space Flight Center has prime responsibility; it is the basic planning document for the preparation of tests. Described in addition are intercarrier verification tests required to demonstrate the compatibility of all launch and orbit experiment module configurations of the Combined Mission, Flights AAP 1/2/3/4. The development tests include the Lunar Mapping and Scientific Survey development; Airlock Module; Orbital Module; Multiple Docking Adapter; Resupply Module; Lunar Module/Apollo Telescope Mount; and cluster development. The carrier qualification tests include the S-IVB carrier; the Instrument Unit carrier; the Multiple Docking Adapter carrier; the Resupply Module; and the Apollo Telescope Mount/Rack carrier. K.W.

N68-24722*# National Aeronautics and Space Administration, Washington, D. C.
PROJECT: SOUTH ATLANTIC ANOMALY PROBE (SAAP)
2 Jun. 1968 20 p
(NASA News Release-68-97K) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Prelaunch data are presented on the South Atlantic Anomaly Probe (SAAP) designed to carry a scientific payload for evaluating the radiation environment over the South Atlantic. Scheduled for launch by a Black Brant 4 from Natal, Brazil, the experiment package will consist of magnetometers for magnetic field measurements, a five-channel electron spectrometer for defining the electron flux of the anomaly, three ion chambers for radiation dose measurements, and a heavy ion detector. Background information is included on the flight events, experiment hardware, SAAP hardware, the experiment battery pack, and the Black Brant 4. M.G.J.

N68-24738*# Boeing Co., Seattle, Wash.
LUNAR ORBITER 3: PHOTOGRAPHIC MISSION SUMMARY
Washington NASA May 1968 117 p
(Contract NAS1-3800)
(NASA-CR-1069) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Summary information is given on the photographic mission of Lunar Orbiter III. The primary objective of the mission was to obtain, from lunar orbit, detailed photographic information of various

lunar areas, to assess their suitability as landing sites for Apollo and Surveyor spacecraft, and to improve our knowledge of the moon. The performance of each of the subsystems is discussed along with the operational performance of the spacecraft. The general design of the spacecraft is given, and launch preparation and operations are delineated. The performance and function of each of the ground stations and facilities necessary to sustain mission operations are also considered. Details are given on the photographic, lunar environmental, tracking, and performance data obtained from the spacecraft. Tabulated data are presented on a comparison of predicted and actual performance. B.S.D.

N68-24918*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
OGO-E SPACE VEHICLE RESPONSE TO TRANSIENT LOADING AT ATLAS BOOSTER ENGINE CUTOFF
M. E. Alper, W. H. Gayman, M. R. Tur Apr. 1968 186 p refs
(Contract NAS7-100)
(NASA-CR-94761; JPL-900-128) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Computer programs are developed to predict the structural response of the Orbiting Geophysical Observatory (OGO-E) spacecraft to an expected Atlas booster engine cut-off by analyzing flight data from Ranger flights during booster cut-off. Considered are: (1) angular acceleration of the spacecraft base and at two points of the spacecraft; (2) linear acceleration at 3 points of the spacecraft; and (3) the torque force at the spacecraft base. Time histories of the responses are computed together with their Fourier transforms and peak responses are indicated. G.G.

N68-24923*# Boeing Co., Seattle, Wash.
LUNAR ORBITER 5: MISSION SYSTEM PERFORMANCE
4 Jan. 1968 143 p
(Contract NAS1-3800)
(NASA-CR-66608; D2-100755-3) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The presented performance analysis of the Lunar Orbiter 5 and its subsystems covers launch operations, flight conduct and flight path control information, as well as discussions of the various anomalies encountered during the extended missions. The configuration of the Atlas–Agena launch vehicle for mission 5 was identical to the mission 4 vehicle and the same basic launch vehicle operations plan was used as during the first four missions. G.G.

N68-24934*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A DISCUSSION OF THE STABILITY REQUIREMENTS FOR A LAUNCH VEHICLE FLIGHT CONTROL SYSTEM
Jerome R. Redus 1 May 1968 17 p refs
(NASA-TM-X-53735) CFSTI: HC $3.00/MF $0.65 CSCL 22D

It is asserted that what is truly desired of a launch vehicle flight control system is the ability to bound the dynamic responses of the launch vehicle to winds aloft and vehicle anomalies. Within this context, the necessity of imposing the customary stability requirements on a launch vehicle flight control system is questioned. Arguments for and against the usual stability requirements are presented. It is concluded that the question is an important one which needs resolution. Author

N68-24945*# General Dynamics Corp., San Diego, Calif.
DYNAMIC STABILITY OF SPACE VEHICLES. VOLUME 12: RE-ENTRY VEHICLE LANDING ABILITY AND CONTROL
B. J. Kuchta Washington NASA May 1968 80 p refs
(Contract NAS8-11486)
(NASA-CR-946) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The control and stability aspects of spacecraft just prior to and during touchdown are considered. The ground rules and requirements set forth for landing criteria are based upon present day knowledge. Low lift-over-drag ratio operational spacecraft with a parachute recovery system are discussed with respect to maneuverable and nonmaneuverable landing systems. A description of the Apollo re-entry and landing system is used to describe the general problem areas and constraints of a re-entry and landing system. Horizontal landing spacecraft of fixed and variable geometry are answered, and a method for evaluating landing characteristics of horizontal landing spacecraft is presented. A powered rotor and sustained-propulsive-lift system are two powered modes examined to assist powered landing spacecraft. B.S.D.

N68-24964*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC CHARACTERISTICS OF A MODIFIED CONE-CONICAL-FRUSTUM ENTRY CONFIGURATION AT MACH 6.0
George C. Ashby, Jr. and W. Frank Staylor Washington, D. C. Jun. 1968 19 p refs
(NASA-TN-D-4598) CFSTI: HC $3.00/MF $0.65 CSCL 22B

An investigation of the internal arrangement and the stability and control of a modified cone-conical frustum entry vehicle has been conducted. The internal arrangement was made to house eight men in orbit for 24 hours and included a propulsive lift system for hover and landing. The experimental tests were conducted at Mach 6.0 and a Reynolds number based on model length of 6.3×10^6. Trailing-edge flaps symmetrically arranged were used to trim the vehicle. The results show that the configuration is stable about all axes and can be trimmed about a center of gravity at 60 percent of the length with a maximum lift-drag ratio of 1.57 and a static margin of 3.5 percent. Calculations made by using a basic Newtonian computer program predicted the forces very well but overestimated the moments. Author

N68-25009*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE MARINER VENUS 67 MAGNETIC FIELD CONTROL PROGRAM
Joseph G. Bastow 15 Apr. 1968 36 p refs
(Contract NAS7-100)
(NASA-CR-94667; JPL-TR-32-1269) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Magnetic control efforts were limited to reducing and stabilizing the magnetic field of exhisting hardware and to obtaining more meaningful information on the magnetic condition of the hardware. All type approval hardware was magnetized and demagnetized and, if no adverse demagnetization effects were observed, all flight hardware was demagnetized to erase the effects of environmental testing and to stabilize and reduce the magnetic field. Magnetic mapping data were processed by computer to provide the magnetic field components of the extrapolated field in spacecraft coordinates at the spacecraft magnetometer sensor. These field components were summed and compared with the mapped field of the complete spacecraft. The results of this program clearly demonstrate that a spacecraft can have a low total field and yet be made up of many subassemblies with very large, and potentially unstable, magnetic fields. The results of the technique of summing the subassembly fields, when compared with the total spacecraft mapped field, show significant correlation and provide insight into the effect of removing or adding a single item of hardware on the total spacecraft field. Author

N68-25177*# Chrysler Corp., New Orleans, La. Space Div.
SATURN AS-204/LM-1 POSTFLIGHT TRAJECTORY, PART 4
J. W. Nichols Apr. 1968 136 p
(Contract NAS8-4016)
(NASA-CR-94709; TN-AP-68-311, Pt. 4) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The Apollo Saturn Vehicle, AS-204/LM-1, was launched from Cape Kennedy, Florida, at 5:46:08 P.M. EST on January 22, 1968. The primary mission of this flight was to place the Lunar Module in an elliptical earth orbit (85 by 120 nm) for unmanned tests of the spacecraft and subsystems operations. This report presents the AS-204/LM-1 postflight trajectory from guidance reference release to S-IVB/LM-1 separation. The trajectory is presented in the earth-fixed plumbline. The trajectory was established from data provided by external electronic tracking systems and telemetered onboard data from the ST-124M guidance platform. The postflight trajectory was very close to the predicted nominal. At S-IVB/LM-1 separation (3235.24 sec) the vehicle had a space-fixed velocity of only 0.9 m/s (2.9 ft/s) greater than nominal. The altitude, at this point, was 1.2 km (0.6 nm) lower than nominal and the flight path angle was 0.005 deg less than nominal. Author

N68-25358*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LUNAR FAR-SIDE COMMUNICATION SATELLITES
P. E. Schmid Washington, D. C. Jun. 1968 23 p refs
(NASA-TN-D-4509) CFSTI: HC $3.00/MF $0.65 CSCL 22B

This report discusses a lunar communication satellite relaying signals to and from points up to 200 km above the lunar far side surface. Two lunar satellite geometries are considered, namely, a libration point satellite anchored 65,000 km behind the moon and a 1000 km lunar orbiting relay satellite. Author

N68-25370*# Volt Technical Corp., Washington, D. C.
PROGRAM COMPLETED
Greenbelt, Md. NASA. Goddard Space Flight Center 29 May 1968 3 p Transl. into ENGLISH of TASS Communiques (USSR), 20 Apr. 1968
(Contract NAS5-12487)
(NASA-CR-94771; ST-PR-10719) CFSTI: HC $3.00/MF $0.65 CSCL 22B

This TASS communique briefly describes the orbital rendezvous and docking experiment of the Cosmos 212 and 213 satellites which was performed on command by on-board computers. Some of the other experiments conducted with these satellites are also mentioned. R.N.A.

N68-25396*# TRW Systems, Redondo Beach, Calif.
SCOUT ERROR ANALYSIS, PHASE 1 Final Report
L. B. Cohen [1967] 167 p refs
(Contract NAS1-6969)
(NASA-CR-66596; TRW-07919-6001-R000) CFSTI: HC $3.00/MF $0.65 CSCL 22D

Error sources and their magnitudes are discussed in terms of field data and postflight reports for the Scout vehicle. A digital simulation incorporated six dimensional dynamics and the modeling of the second and third stage on–off control systems, with 103 error sources used in this simulation. Both linear and high order sensitivity coefficients were generated for use in a Monte Carlo type program, and analysis of a polar mission with 200 n.mi. perigee and 1000 n.mi. apogee produced results that agreed quite closely with the observed flight results when the two outlier flights were neglected. Of the 103 errors, 29 were significant; and a bias was discovered in the velocity vector at burnout of 13 ft/sec that was noted also in the postflight reconstructions. M.W.R.

N68-25469# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.
THE SATURN S-4-B STAGE AS A TEST BED FOR BOOSTER RECOVERY
Phil Bono and T. J. Gordon [1966] 26 p Presented at the 6th European Symp. on Space Technol., Brighton, England, 23–25 May 1966
(Douglas Paper-3808)

This paper describes the incoroporation of a modification kit weighing 6500 pounds to the Saturn S-IVB stage for complete state recovery, including all the necessary recovery system elements. As a result, a nominal mission with a 26,000-pound payload injected into orbit could be performed with the Saturn IB launch vehicle. The S-IVB (orbital) stage would then be ocean-recovered from orbit after successful mission completion. The paper also discusses how the modified S-IVB flight test item could lead, through further refinements, to a demonstration "test bed" for eventual land-recovery. In conclusion, the paper describes the additional modifications which would permit the basic S-IVB stage to acquire orbital velocity as a single-stage device, and the potential future applications of such a ballistic rocket for global (terrestrial) transportation of passengers and cargo. Author

N68-25487*# Goodyear Aerospace Corp., Akron, Ohio.
DEVELOPMENT OF ATTACHED INFLATABLE DECELERATORS FOR SUPERSONIC APPLICATION
R. Reed Barton 22 May 1968 148 p refs
(Contract NAS1-7359)
(NASA-CR-66613; GER-13680) CFSTI: HC $3.00/MF $0.65 CSCL 22B

An attached inflatable decelerator is considered for augmenting needed drag of a capsule during Mars entry. The inflatable afterbody, configured as a variation from a tucked-back BALLUTE, is packaged within a 120-deg conical aeroshell for deployment at Mach 3.0 and at a dynamic pressure of 125 psf. Outer attachment of the expandable afterbody is made to the hardbody aeroshell profile, and inner attachment is made to a tubular support for wind-tunnel mounting. The model was designed, fabricated, and development tested and is recommended for wind-tunnel testing to prove workability of the concept. This report discusses design conditions, requirements, documentation, materials selection, development tests, and conclusions. Author

N68-25577*# McDonnell-Douglas Co., St. Louis, Mo.
PROJECT GEMINI: A TECHNICAL SUMMARY
P. W. Malik and G. A. Souris Washington, D. C. NASA Jun. 1968 350 p
(Contract NAS9-170)
(NASA-CR-1106) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Spacecraft and major systems, overall mission planning, and experiments are detailed for the Gemini project. Following an introduction that notes the modular design concept, presents the major objectives, and stresses safety first; the spacecraft reentry module, adapter module, and heat protection are described. The structural qualification testing and the reliability and quality assurance programs are summarized. Attention is given to the electrical, communication and tracking, rendezvous radar, digital command, and time reference systems; as well as to the instrumentation and recording, guidance and control, propulsion, environmental control, escape, and landing and recovery systems. Pyrotechnics and the crew station are also considered, as are details for the target docking adapter and the augmented target docking adapter. M.W.R.

N68-25649*# California Inst. of Tech., Pasadena.
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION JET PROPULSION LABORATORY 1966 ANNUAL REPORT
[1967] 42 p
(NASA-CR-94683) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Surveyor, Mariner, and Voyager research activities are discussed, as is the role of the Deep Space Network in Mariner 4 reacquisition, radiation patterns from Surveyor signals,

station-to-station time synchronization using Lunar Orbiter, and traveling wave maser system. Research in the areas of fluid physics, electrophysics, materials, and applied mathematics is summarized in an effort to amass new knowledge of physical phenomena; and bioscience efforts are concentrated on exobiology supporting research and the Automated Biological Laboratory (ABL). Also reported are space science and technology flight experiments, electronics research, spacecraft and capsule aerothermomechanical engineering, and propulsion. Financial management and procurement for the laboratory are considered along with patents and new technology and the various facilities in use or in the planning stage.
M.W.R.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N68-24346# Sandia Corp., Albuquerque, N. Mex. Analytical Development Div.
RESPONSE OF AN ELASTIC, INFINITE, CYLINDRICAL SHELL TO INITIAL MEMBRANE AND BENDING STRESSES
Walter B. Murfin Jan. 1968 17 p
(Contract AT(29-1)-789)
(SC-TM-67-3025) CFSTI: HC $3.00/MF $0.65

A modal solution is developed for coupled membrane and bending stresses in a cylindrical shell with initial stress distribution. It is shown that coupling is relatively unimportant. It is also shown that conduction is of little importance when the initial stresses result from initial temperatures. Author (NSA)

N68-24360# Sandia Corp., Albuquerque, N. Mex.
AN IZOD-ROGOWSKI IMPACT TEST
R. R. Sowell and O. Milton Jan. 1968 22 p refs
(Contract AT(29-1)-789)
(SC-RR-67-832) CFSTI: HC $3.00/MF $0.65

The Izod impact test was modified for the use of a plastic test specimen fabricated with a Rogowski contour in place of the usual notch. It was found that the energy required to break the test specimen was dependent upon the temperature of the specimen and that a significant change in the energy required for break occurred at the glass transition temperature of the material of the specimen. It was also found that the energy values obtained for a sample lot of test specimens fit an extreme value statistics and thus allow interpretation of data scatter. Author (NSA)

N68-24364# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.
DISPERSION OF FLEXURAL WAVES IN CIRCULAR, BI-MATERIAL CYLINDERS
Robert Carl Reuter, Jr. Jul. 1967 54 p refs
(Contract NOw-66-0360-d)
(T&AM-298; AD-667723)

The frequency equation for flexural waves traveling in an infinitely long, bi-material, circular cylinder is obtained, using an extension of the Pochhammer-Chree theory for homogeneous rods. Several lowest branches of the frequency equation are presented and discussed for various ratios of the constituent cylinder radii. Experimental data are furnished and the range of applicability and accuracy of the theory are discussed. Author (TAB)

N68-24373# Suffield Experimental Station, Ralston (Alberta).
PRESSURE MEASUREMENTS ON A HEMISPHERICAL SURFACE INTERACTING WITH A SHOCK WAVE
J. J. Gottlieb 26 Feb. 1968 20 p refs
(Suffield-Memo-89/67) CFSTI: HC $3.00/MF $0.65

The pressure over a hemispherical surface from the interaction of a shock wave was measured in a shock tube. An empirical equation was developed to describe the peak pressure measured over the surface of the hemisphere. The empirical equation is compared to the theoretical equations for the pressure from regular and mach reflection on a plane wall inclined to the incident shock wave. Author

N68-24386# Sandia Corp., Albuquerque, N. Mex. Deformation of Structures Div.
UNIVALVE: A COMPUTER CODE FOR ANALYZING DYNAMIC LARGE DEFLECTION ELASTIC-PLASTIC RESPONSE OF BEAMS AND RINGS
R. D. Krieg and S. W. Key Jan. 1968 154 p refs
(Contract AT(29-1)-789)
(SC-RR-66-2682) CFSTI: HC $3.00/MF $0.65

UNIVALVE is a FORTRAN code which computes the dynamic response of beams and rings of arbitrary plane configuration whose motion is two-dimensional. The beam material may be elastic-plastic, strain hardening, and strain rate sensitive. Arbitrarily large deflections are allowed. It may be acted upon by time and space dependent loads, initial velocities, and initial stresses. Many combinations of boundary conditions are handled. The final equilibrium shape is also found. The report contains derivations of the differential equations. The method of solving these by finite differencing in time and space is presented in detail. Flow charts, program listings, and input instructions are included. Sample calculations are presented and compared with theoretical results. Author (NSA)

N68-24391# Illinois Univ., Urbana, Ill. Dept. of Theoretical and Applied Mechanics.
DISCONTINUOUS MODE OF CRACK EXTENSION IN UNIDIRECTIONAL COMPOSITES Final Technical Report
Edward M. Wu Feb. 1968 26 p refs
(Contract NOw-66-0360-d)
(T&AM-309; AD-667724)

In the microscopic examination of cracks in fiberglass, it was observed that the crack made microscopic skips across the fiber. The direction of skipping is strongly influenced by the tensile stress perpendicular to the fiber. As a consequence, the crack skipping has a preferred orientation under skew-symmetric loading. It was observed that when the direction of shear was reversed the preferred crack skipping direction was reversed also. Due to the crack skipping mode of crack propagation, the usual analysis for a straight crack is no longer valid. A mathematical model was developed to describe this mode of crack extension. The fiberglass stringers were replaced by their equivalent forces and the crack is reduced to a straight line. Experiments in propagating the crack with full reversal of the shear force substantiate the validity of the mathematical model. With this stringer force model, it can be seen that, at least quantitatively, the constant strain energy release rate can be a fracture criterion for cracks under combined symmetric and skew symmetric loads. The major usefulness of this stringer force model probably lies in the analysis of crack propagation under cyclic loading. With this model, the influence of mean stress can be analyzed and the mechanism of crack growth can be more fully investigated. Author (TAB)

N68-24412*# General Electric Co., Philadelphia, Pa. Missiles and Space Div.
STRUCTURAL DESIGN CONCEPTS FOR THE EFFICIENT UTILIZATION OF FIBROUS COMPOSITE MATERIALS

B. Walter Rosen and Norris F. Dow Feb. 1968 40 p refs
(Contracts NASw-1377; N00014-C-0167)
(NASA-CR-94658; AD-667477) CSCL 20K

The design of compression structures which can utilize the very high uniaxial strength and stiffness of fibrous composites is studied. Basic structural elements, namely, columns, plates and cylindrical shells are examined. Combinations of isotropic metals or composites for biaxial stiffness with unidirectional composites for strength are studied. Tentative failure criteria are established for use in the structural efficiency studies. The analyses indicate that combinations of advanced unidirectional composites with isotropic materials yield substantial improvements with respect to designs utilizing a single material. The promising configurations are: layered combinations of unidirectional composites and isotropic metals; unidirectional stiffeners on isotropic composite tubes; and skeleton or truss-like cylindrical shells with unidirectional composite members. Author (TAB)

N68-24419# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
ELASTIC STABILITY OF SPHERICAL SHELLS SUBJECTED TO EXTERNAL PRESSURE
Megumi Sunakana Mar. 1968 27 p refs *Its* Vol. 33, No. 5 (ISAS-423, V. 33, No. 5) CFSTI: HC $3.00/MF $0.65

The nonlinear fundamental equations of a spherical shell for thermoelastic problems, subjected to the pressure and the change in temperature, are derived first of all, taking a large deformation into account. Then, the equations are solved approximately assuming the deformation pattern to be the axisymmetric damped wave. The relations between the external pressure and the deflection at the center of the shell are obtained by use of the Galerkin method and the critical pressures are discussed based on the author's viewpoint that the buckling phenomenon of spherical shell is of a local one at the initial stage of its occurrence and the localized deformation has the triggering effect in inducing the much larger dynamic deformation and that the buckling process of spherical shell under external pressure is of a "snapping through". The result obtained seems to be one of the promising contributions to bridge the gap between the theoretical and experimental values of the problem. Author

N68-24439*# Kansas Univ., Lawrence. Center for Research in Engineering Science.
AN INVESTIGATION OF DYNAMIC INSTABILITY OF STIFFENED RECTANGULAR PLATES
Roger C. Duffield and Nicholas Willems Mar. 1968 85 p refs
(Grant NsG-298)
(NASA-CR-94675; Rept.-28) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Boundaries of the regions of parametric instability were determined for the principal resonance of a simply supported stiffened rectangular plate subjected to periodic in-plane boundary forces, and the effects of size and location of the stiffeners on these boundaries were studied. Experimental verification was obtained for stiffened plates with a single centrally located stiffener transverse to an in-plane boundary force acting on two opposite edges. A discrete element model, which correctly predicted boundaries of the instability region, showed good agreement with experimental results; and the theory developed completely predicted that parametric response, natural frequencies, and static buckling values. The most dangerous region of instability, from the standpoint of width, is the first temporal mode associated with the spatial mode closest to the fundamental static stability mode. For the cases studied, the greatest single effect on the location of the boundaries of the instability regions was caused by the increase of the rigidity of either a rib or a stringer to the point which corresponds with a spatial mode other than the first one. M.W.R.

N68-24451 National Lucht-en Ruintevaartlaboratorium, Amsterdam (Netherlands).
FATIGUE TEST ON SINGLE LAP JOINTS IN CLAD 2024-T3 ALUMINIUM ALLOY MANUFACTURED BY A COMBINATION OF RIVETING AND ADHESIVE BONDING
A. Hartman Dec. 1966 70 p
(NLR-TN-M.2170)

Fluctuating tensile fatigue tests with a constant stress ratio R = 0.1 were made on 2024-T3 alclad single lap joint specimens manufactured by a combination of riveting and adhesive bonding with a room temperature curing epoxy-adhesive. The specimens with 0.8 mm sheet thickness and three rows of 2024 aluminum alloy countersunk rivets (ϕ 3.2 mm). The following effects on the fatigue strength were studied: (1) Temperature of testing (2) Type of adhesive, (3) Pretreatment of the metal, (4) Frequency of loading and, (5) Artificial ageing for 4 weeks in warm wet air of 70°C and 98–100% R.H. For comparative purposes fatigue tests on a few series of adhesive bonded specimens and on one series of riveted specimens were included in the investigation. Author

N68-24463# General Electric Co., Philadelphia, Pa. Missile and Space Div.
DYNAMIC STABILITY OF STRUCTURES SUBJECTED TO STOCHASTIC EXCITATION
John Anthony Lepore 22 Aug. 1967 168 p refs
(Doc.-67SD299)

This paper deals with a Lyapunov type analysis of linear structural dynamic systems which are excited by a stochastic parametric load. Theories for mean square stability, mean square asymptotic stability and mean square global stability are established corresponding to the deterministic case. An axially loaded linearly elastic column and a radially-loaded circular plate are considered. A Lyapunov function satisfying the stochastic stability theorem, is developed and sufficient conditions are established to insure mean square global stability. These conditions are expressed in terms of the mean and variance of the absolute value of the excitation, physical parameters of the system and a measure of the stochastic dependency of the output on the input. Regions of mean square global stability are defined and the general behavior of these regions are studied. Author

N68-24481*# Lockheed Aircraft Corp., Sunnyvale, Calif.
BUCKLING OF SHELLS OF REVOLUTION WITH VARIOUS WALL CONSTRUCTIONS. VOLUME 1: NUMERICAL RESULTS
B. O. Almroth, D. Bushnell, and L. H. Sobel Washington NASA May 1968 58 p refs
(Contract NAS1-6073)
(NASA-CR-1049; Rept.-4-17-67-1) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Results are presented on a parameter study performed with the computer program BOSOR (Buckling of Shells of Revolution). The axisymmetric collapse and the nonsymmetric bifurcation buckling behavior is studied for cylinders, cones, and spherical and toroidal shell segments subjected to axial compressive loads. Particular emphasis is placed on the effects of eccentricity in load application and on the influence of elastic end rings. Author

N68-24496# European Atomic Energy Community, Ispra (Italy).
CALCULATING THE CRITICAL VELOCITIES OF A CHOPPER
M. Biggio Brussels Apr. 1968 64 p refs
(EUR-3883.E) CFSTI: HC $3.00/MF $0.65

This report deals with the calculation of the critical velocities—those due to torsional, flexional and precession movements—of a "chopper". The purpose of the report is to show the process by which these speeds are calculated for an unusual mechanical

system. The approach is not new in itself, being that traditionally used in mechanical engineering. We believe, however, that a demonstration of the working of the problem right through to the numerical value will help to overcome the difficulties which would inevitably be encountered by anyone working solely on the basis of the general principles which we took as starting point. Author

N68-24508*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FLUCTUATING PRESSURES ON THE AFTERBODIES OF FIVE BLUNT ATMOSPHERE ENTRY VEHICLES

Robert C. Robinson, Bruno J. Gambucci, and Robert E. George Washington May 1968 56 p refs

(NASA-TN-D-4591) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Pressure fluctuations were measured on the afterbodies of entry-vehicle configurations at angles of attack from −14° to +14° and Mach numbers from 0.60 to 3.50. The Reynolds number range was 2.0×10^6 to 6.5×10^6 based on model diameter. The models were typical of configurations which have been considered as entry vehicles for the Mars atmosphere. Forebody fineness ratios were 1/3 and 1/8 and the afterbodies were conical with half angles of 30°, 60°, and 80°. The pressure fluctuations measured at subsonic Mach numbers were of low reduced frequency (below 0.30) and were highly correlated. At supersonic Mach numbers the bandwidth of the fluctuations increased and the degree of correlation decreased with increasing Mach number. Author

N68-24519# General Electric Co., Philadelphia, Pa.

DYNAMICS OF LINEAR ELASTIC SOLIDS AND COUPLED SYSTEMS OF SOLIDS AND STRUCTURES

Yi-Yuan Yu 18 May 1967 34 p refs

(Rept.-67-SD-262)

The method of determining the dynamic response of a large space system by means of the characteristics of its subsystems was previously explored, but only force input was considered. In the present paper the treatment is generalized to allow for motion input. By again starting with Hamilton's principle for an elastic solid as in the companion paper, two preliminary problems are solved first: one being a static problem with the prescribed displacement associated with the original motion input, and the other consisting of the usual free-vibration analysis. The dynamic analysis of a solid subjected to arbitrary force and motion input is then again reduced to that of single-degree-of-freedom systems. From the results of a general three -dimensional solid are deduced the results of the Timoshenko beam as an example. Through the use of receptances as before, coupled systems of solids and structures are next treated, with joined Timoshenko beams finally analyzed as an example. Author

N68-24591# California Univ., Livermore. Lawrence Radiation Lab.

A MONTE CARLO SOLUTION TO THE PROBLEM OF TORSION OF PRISMATIC BARS

R. B. Carr 7 Aug. 1967 12 p Presented at the 4th Southeastern Conf. on Theoret. and Appl. Mech., New Orleans, 29 Feb.–1 Mar. 1968

(Contract W-7405-ENG-48)

(UCRL-70600; CONF-680201) CFSTI: HC $3.00/MF $0.65

The application of a Monte Carlo technique to the problem of torsion of a constant cross-section bar of arbitrary shape is described. The use of this method demonstrates the procedure of solving a class of solid mechanics problems by a numerical technique that requires no prior zoning of the shape being investigated, and also obtains the shear stress at a single point without solving for the total stress distribution. It is shown that obtaining the derivative of a stress function that satisfies Laplace's equation converges to within 5 percent of the analytical solution for shear stress near a semicircular notch in a circular shaft by only using 20,000 random walks for the stress function. Author (NSA)

N68-24656*# Louisiana State Univ., Baton Rouge. Div. of Engineering Research.

THE THERMAL CONDUCTANCE OF BOLTED JOINTS

John Elton Fontenot, Jr. (Ph.D. Thesis) Feb. 1968 206 p refs

(Grant NGR-19-001-035)

(NASA-CR-94738) CFSTI: HC $3.00/MF $0.65 CSCL 20K

An analytical method of determining the interface thermal conductance of a bolted joint from a minimum of design information was developed. A new approximate method was developed for thin bolted plates and was shown to yield interface stress distributions which, when used to calculate plate deflections, produced deflections in good agreement with experimental measurements. An analytical method, using the technique of superposition, was developed and programmed to describe the deflection of thin circular plates with center holes, subject to nonuniform partial loading. Calculated and measured plate deflection values were in good agreement. Interface pressures and plate deflections, determined from bolthead and joint interface stresses, were used in equations to determine thermal conductance of two bolted joints in the region of interfacial contact and in the zone of interfacial separation. The thermal conductance values were used in a finite difference heat transfer analysis to determine the steady state temperature gradients across aluminum and stainless steel bolted joints in air and vacuum. R.N.A.

N68-24684# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany).

STABILITY INVESTIGATION OF THINWALLED CIRCULAR CYLINDERS IN POSTBUCKLING REGION [STABILITAETSBERECHNUNG FUER DUENNWANDIGE KREISZYLINDER IN NACHBEULBEREICH]

M. Esslinger Dec. 1967 42 p refs In GERMAN; ENGLISH summary

(DLR-FB-67-70) CFSTI: HC $3.00/MF $0.65

A calculation procedure for the investigation of the stability of postbuckling equilibrium states is derived for the case of thin-walled circular cylinders subjected to axisymmetric loading. The application of the procedure is demonstrated for an isotropic cylinder, with and without initial imperfections, loaded by hydrostatic pressure. The numerical results are compared with test results. Author

N68-24689 Washington Univ., Seattle.

NON-LINEAR PHOTOMECHANICS

Peravali Ramanaiah (Ph.D. Thesis) 1966 63 p

Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-2188

The classical theory of photoelasticity is based on the assumption that the dielectric tensor at time t is directly proportional to the strain tensor at time t. More generally, observations indicate that the dielectric tensor at any time depends on the entire deformation history. In this article, a particular class of simple materials with electromechanical fading memory are considered. In particular an approximate photomechanical constitutive equation is derived for the case where the deformations are infinitesimal in the recent past but may be finite in the distant past. The resulting theory of non-linear photomechanics is shown to contain the theories of linear photoelasticity and photoviscoelasticity as special cases. Using this theory, the extension of photoelasticity to solve stress analysis problems for non-linear viscoelasticity and non-linear elasticity is indicated. It is also shown that a limited class of problems in plasticity can be solved. Dissert. Abstr.

N68-24801 Flugtechnisches Ingenieurbuero, Munich (West Germany).

SCREENING OF LITERATURE ON DESIGN LOADS FOR UNMANNED ROCKET-STAGES [SICHTUNG VON LITERATUR UEBER LASTANNAHMEN FUER UNBEMANNTE RAKETENSTUFEN]

Gerhard Siegel Bad Godesberg, West Ger. Bundesmin. fuer Wiss. Forsch. Jan. 1968 30 p refs In GERMAN; ENGLISH summary (BMwF-FB-W-68-03) CFSTI: HC $3.00/MF $0.65

The study has been carried out for the purpose of screening critically all the available literature in English, French and German on the subject of design loads for unmanned rocket-stages. The result is a compilation of 50 sources. This may be used as reference to suitable literature-sources if design loads for an unmanned rocket-project have to be established. Author

N68-24802*# North American Aviation, Inc., Downey, Calif.
SHELL ANALYSIS MANUAL
E. H. Baker, A. P. Cappelli, L. Kovalevsky, F. L. Rish, and R. M. Verette Washington NASA Apr. 1968 849 p refs
(Contract NAS9-4387)
(NASA-CR-912) CFSTI: HC $3.00/MF $0.65 CSCL 20M

This shell analysis manual provides specific instructions, procedures, basic solutions, and recommendations to facilitate the expedient static structural analysis of shell-type spacecraft structures. It also provides an introduction to and reference for the practical static structural analysis of shells. Author

N68-24844# Suffield Experimental Station, Ralston (Alberta).
DYNAMIC RESPONSE OF SIMPLY-SUPPORTED BEAMS UNDER BLAST LOADING
B. R. Long 16 Feb. 1968 26 p refs
(SUFFIELD-TN-195) CFSTI: HC $3.00/MF $0.65

Visco plastic response of the steel beams is represented by a simple model, while elastic behavior is predicted by the equivalent single degree technique. Theoretical and experimental results are compared. Author

N68-24850 Houston Univ., Tex.
THE EFFECT OF PLANE-SYMMETRIC MASS LOADING ON THE RESPONSE OF RING-STIFFENED CYLINDRICAL SHELLS
Constantine Demetrius Michalopoulos (Ph.D. Thesis) 1966 108 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-2018

The present investigation is an analytical study of the invacuo vibrations of a simply supported, mass-loaded thin cylindrical shell which is reinforced by equally spaced ring stiffeners. Four masses are attached to each stiffening ring in a plane-symmetric fashion. The angular position of two of the masses is fixed, but that of the other two can be varied. The rotatory inertia of the masses is taken into account, but similar effects for the shell and ring stiffeners are neglected. Lagrange's equations are used to derive the dynamic equations of the shell structure and the Jacobi iteration method is employed to find the natural frequencies and corresponding mode shapes. Results are given for various values and angular position of the masses to show the effects of mass loading. When the value of the masses is allowed to become zero, the results for the ring-stiffened shell are in close agreement with those of previous investigators. Dissert. Abstr.

N68-24857# Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
BUCKLING OF CYLINDRICAL SHELLS UNDER LONGITUDINAL SHEAR LOADS
Menahem Baruch and Ovadia Harari Nov. 1967 40 p refs
(TN-81; TAE-81) CFSTI: HC $3.00/MF $0.65

The influence of the in-plane boundary conditions for simply supported cylindrical shells is analyzed. A combination of longitudinal shear load and uniform axial compression is also studied. It is found that, as in the case of axial compression, the critical longitudinal shear load for the weaker circumferential boundary conditions ($N_{x\phi}$ 0) is about half of that of "classical" boundary conditions. Author

N68-24937 Virginia Polytechnic Inst., Blacksburg.
UNSYMMETRICAL LARGE DEFLECTIONS OF AN ANNULAR PLATE
William Edmund Alzheimer (Ph.D. Thesis) 1967 102 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-1313

A systematic mathematical iteration technique is used to obtain a solution to the von Karman equations for an annulus fixed at the outer edge and which has a central rigid plug that is rotated about its diameter out of the plane of the plate. The linear, small-deflection solution to this problem is used as the first approximation for large deflections. A linear fourth order partial differential equation for the stress function is obtained. The particular solution to the stress function equation leads to multi-valued in-plane displacements, which are eliminated by proper selection of the homogeneous solution. The boundary conditions for the stress function equation are written in terms of the inplane displacements, and wherever trigonometric functions of the small angle of rotation of the rigid inclusion appear, they are expressed in a power series of the angle and terms of higher order than the second power are neglected. Dissert. Abstr.

N68-24939 Alabama Univ., University.
SOME LINEAR ELASTOSTATIC BOUNDARY VALUE PROBLEMS FOR COMPOSITE MATERIALS
James Gleason Goree (Ph.D. Thesis) 1966 100 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-1324

Solutions are presented for three different linear elastostatic boundary value problems pertaining to infinite bodies which contain voids or inclusions. The first section of the thesis contains an analysis of the three dimensional axisymmetric mixed boundary value problem of an infinite body containing two identical partially bonded rigid spherical inclusions and subjected to an axisymmetric torsional stress field. In the second section a study is made regarding the problem of longitudinal or transverse shear stresses in a body which is uniformly stressed at infinity and contains two perfectly bonded circular cylindrical inclusions of arbitrary size, elastic properties, and spacing. The last section presents a solution for the three dimensional axisymmetric contact stress problem of an infinite body containing a smooth spherical elastic inclusion and subjected to an axisymmetric stress state at infinity. Numerical results are presented for each problem. Computer programs for the above problems are contained in appendices. Dissert. Abstr.

N68-24953 State Univ. of Iowa, Iowa City.
AN EXTENSION OF SECOND-ORDER ELASTICITY
Roger Owen Stafford (Ph.D. Thesis) 1966 87 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-2682

This study was undertaken to extend the theory of second-order elasticity to cover a more general state of deformation. The discussion is limited to the theory of finite plane strain superposed on a uniform axial extension with general body forces acting in the plane. It is shown that the uniform axial extension need not be zero in the method of successive approximations developed herein and the theory of second-order plane strain for incompressible materials is redeveloped to include this effect. Finally the theory of second-order plane strain for compressible materials is redeveloped to include general body forces and finite axial extension. Complex coordinates are introduced and the equations are formally solved in terms of potential functions. The boundary conditions are throughly investigated and it is shown that, for the first fundamental boundary-value problems of infinite bodies, the difference between solutions in undeformed and deformed body coordinates is created merely by the conditions on the finite boundary. Dissert. Abstr.

N68-24954 Pennsylvania State Univ., University Park.
DISCRETE ANALYSIS METHODS IN MECHANICS OF DEFORMABLE SOLIDS
Pravin Kalidas Mehta (Ph.D. Thesis) 1966 137 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-1943

This thesis deals with an approach to a direct numerical analysis of a group of dynamic and static problems in the mechanics of deformable solids. The analysis is based on the direct use of the governing physical laws and kinetmatical relations together with the initial and boundary conditions to effect changes in the system by steps in order to arrive at the final results, thus bypassing the differential equations as a dispensable intermediate step. The method is first developed for plane elastic stress wave propagation in thin bars and is then extended to the problems of spherical and cylindrical elastic and elastoplastic wave propagation. A linearly strain hardening material is assumed. By applying an arbitrarily chosen exponential damping to the particle velocities, corresponding static states are reached from the dynamic states. We are thus able to unify the problems associated with two hyperbolic and two elliptic differential equations. Dissert. Abstr.

N68-24955 Pennsylvania State Univ., University Park.
AN EXPERIMENTAL AND THEORETICAL STUDY OF MOBILITY OF A LONG CYLINDRICAL SHELL
Jerome Lewis Palladino (Ph.D. Thesis) 1966 114 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-1946

The normal mode approach was utilized to predict the theoretical response. The assumed theoretical displacements of the shell obeyed the freely supported end conditions. The end conditions did not obey these conditions for the beam mode of vibration. An approximation was made to account for the beam mode contribution to the total response. The convergence of the normal mode solution was studied. Experimental beam and shell resonances were compared with theory. A study of the variation of theoretical point and transfer mobility, with frequency, was made. The variation of response was longitudinal coordinate for non-resonant drive frequencies was investigated. Included are mathematical derivations of: (1) the normal mode solution that predicts the radial response; (2) equations for shell-ring motion—motion independent of the length; (3) a proof of the approximation to account for the beam mode contribution in the normal mode solution; (4) and a demonstration of the use of contour integration in vibration problems where the series solution is known. Dissert. Abstr.

N68-24956 Texas A&M Univ., College Station.
TRANSVERSE SHEAR DEFORMATION IN THIN SHELLS OF REVOLUTION
Orville Eugene Wheeler (Ph.D. Thesis) 1966 81 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-266

The effect of transverse shear deformation on stresses and deflections in thin shells of revolution is investigated by considering several particular types of shells. First and second approximation solutions with and without transverse shear deformation are derived and a numerical example is presented for a semi-infinite circular cylindrical shell. First approximation solutions with and without transverse shear deformation are determined for spherical shells and indicated for ellipsoidal shells of revolution. The following conclusions are stated: (1) From an engineering point of view, transverse shear deformation may be neglected in analyzing thin shells of revolution. (2) From an engineering point of view, second approximation theories appear to offer no advantages over first approximation theories for analyzing thin shells of revolution. Dissert. Abstr.

N68-24971*# North American Aviation, Inc., Columbus, Ohio.
INFRARED RADIOMETRIC STRESS INSTRUMENTATION APPLICATION RANGE STUDY
Milo H. Belgen Washington NASA May 1968 144 p refs (Contract NAS1-6082)
(NASA-CR-1067) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Research was utilized to develop a simplified method for evaluating infrared stress measurement applications and to study typical attainable spatial resolutions and detectable stresses (for selected detectors and windows) as a function of test part temperature and stress oscillation frequency. It appears that room temperature infrared measurements might have accuracies of the same general magnitude as conventional instrumentation, and infrared is likely to be more favorable than conventional instrumentation relative to accuracy and other factors at elevated temperatures. Since infrared measurements yield data on the sum of principal stresses, various combinations of infrared and conventional strain instrumentation could yield many (undefined) types of data not previously within the state of the art. Infrared permits rapid spatial data acquisition by scanning with an analog electronic signal output. Author

N68-24973 Pennsylvania State Univ., University Park.
STRESS CONCENTRATION AROUND SPHERICAL CAVITIES IN STRAIN-GRADIENT DEPENDENT ELASTIC BODIES SUBJECTED TO UNIAXIAL TENSION
Glenn Alan Hazen (Ph.D. Thesis) 1966 114 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-1930

In the so-called strain-gradient theory potential energy can be defined in more than one way. In the present problem the analysis is carried out in three such forms. In general there is no reason to prefer any particular form of the theory for solving a boundary-value problem. However, a certain form is especially suited for comparison with couple-stress theory. For this reason, the calculations are carried out for that form of the theory. The solution to the present problem is obtained with the aid of Boussinesq–Papkovitch type stress functions. The stress and displacement fields, which are generated by any of these functions, identically satisfy equilibrium and compatability conditions. The boundary conditions of the present problem are matched by means of a linear combination of a selected set of these functions. Dissert. Abstr.

N68-24993# Lockheed Missiles and Space Co., Palo Alto, Calif.
INFLUENCE OF THE OUTER EDGE ON THE STRESS STATE OF A SPHERICAL SHELL WITH A HOLE
K. I. Shnerenko [1968] 3 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 4, no. 2, 1968 p 123–125
CFSTI: HC $3.00/MF $0.65

An eight dimensional matrix system is used to determine the stress and strain states of a spherical shell weakened by an eccentric circular hole and loaded by internal pressure. The outer contour of the domain is assumed rigidly fixed and the hole is covered by a lid which transmits only the transverse forces to the shell. The influence of the approach of the contours along the line of the center is analyzed by a system of equations through truncation methods; compliance with the boundary conditions on the hole contour was verified with 5% accuracy. Graphs of the stress state components on the outer rigid contour of the shell show that a redistribution occurs as they approach: the free contour is unloaded and the stress concentration grows on the rigid contour. G.G.

N68-24997 Kansas State Univ., Manhattan.
MINIMUM WEIGHT DESIGN OF BEAMS WITH INEQUALITY CONSTRAINTS ON STRESS AND DEFLECTION
Edward Joseph Haug, Jr. (Ph.D. Thesis) 1966 84 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-693

In this dissertation, a beam design problem which has not been found in the literature is treated. A beam which is made of a linearly elastic material of known density is to span two points and support a given load. The cross section of the beam is chosen so as to depend on parameters $u_j(x)$, $j = 1, \ldots, m$, where x is a coordinate measured along the beam. The $u_j(x)$ must be chosen so that when the beam is subjected to the given loading, shear stress and bending stress are below allowable limits and beam deflection, $\gamma(x)$ satisfies the conditions $Y_1(x) \leq \gamma(x) \leq Y_2(x)$ at each point along the beam. From all possible sets of $u_j(x)$ which satisfy these conditions, one is sought for which the weight of the beam is minimum. This problem reduces to a problem in the calculus of variations with side conditions. Dissert. Abstr.

N68-25029 Iowa State Univ. of Science and Technology, Ames.
AN ANALYSIS OF HEAT TRANSFER IN A THERMALLY RADIATING FLUID
Galen Charles Britz (Ph.D. Thesis) 1966 144 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-2042

An analysis of unsteady state heat transfer in a thermally radiating fluid was made. Computer solutions were found for the particular case of supercritical, cryogenic oxygen stored in a heated spherical container. The "exact" calculation of radiant heat transfer was accomplished in a spherically symmetrical system, using a modified zone-interchange method. Radiation heat transfer was found to be of smaller magnitude than conduction heat transfer in the oxygen storage system, but analyses which included radiant heat transfer show significant reduction of temperature gradients. The "jump" temperature phenomenon at a wall occurred as a natural consequence of the rigorous radiation formulation. The existing radiation approximations failed to predict the temperature profiles adequately. A new approximation, which may make the three-dimensional radiation problem tractable, is suggested as a result of this study. The importance of a variable absorption coefficient could not be fully assessed. Dissert. Abstr.

N68-25054# Sandia Corp., Albuquerque, N. Mex.
TRANSIENT RESPONSE OF CYLINDRICAL SHELL-CORE SYSTEMS
W. E. Alzheimer, M. J. Forrestal, and W. B. Murfin [1968] 9 p refs Presented at the AIAA/ASME 9th Struct., Structural Dyn., and Mater. Conf., Palm Springs, Calif., 1-3 Apr. 1968
(Contract AT(29-1)-789)
(SC-DC-67-3210; CONF-680407-1) CFSTI: HC $3.00/MF $0.65

A long, cylindrical shell containing an annular, elastic core is subjected to a circumferentially uniform impulse. The analysis considers propagation and reflection of stress waves in the core, and the inner core boundary is specified as a rigid reflector, a free surface, or a support offered by another shell. Formulae in terms of elementary functions are developed for the shell response by extending approximate techniques previously used in problems associated with diverging cylindrical waves. These approximate shell response formulae are compared with numerical, finite difference solutions, and the two agree to within a few percent. Results are presented for a wide range of shell and core parameters, and the results demonstrate that solutions which neglect the inertial effects in the core can significantly overestimate the shell response. Author (NSA)

N68-25086 Pennsylvania State Univ., University Park.
OPTIMUM MODELLING OF STRUCTURES TO PREDICT DYNAMIC ELASTIC RESPONSE
Hae Lee (Ph.D. Thesis) 1966 146 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-1937

Errors induced by the use of lumped models having equally spaced masses for the dynamic analysis of uniform bars and beams were studied. The lumping error criteria and the required number of lumped elements to meet the desired accuracy for certain dynamic response are obtained. Solutions are obtained for a vibrating bar problem and for the flexural vibrations of beams. The method of constructing optimum mathematical models for structures subjected to steady as well as velocity shock excitation was also studied. A study of factors appearing in the normal mode solution is made for a structure subjected to external disturbances. It is shown that for a structure with time dependent boundary conditions, modal effective factors and mechanical impedance play important roles in formulating optimum mathematical models. An optimum model is obtained for a combined structure composed of springs and beams by matching impedance coefficients of substructures. Dissert. Abstr.

N68-25067 Virginia Polytechnic Inst., Blacksburg.
AN INVESTIGATION OF THE USE OF INERTIA AS A PERTURBATION PARAMETER AND CONTINUED FRACTIONS IN LINEAR VIBRATION PROBLEMS
Jerry Counts (Ph.D. Thesis) 1967 75 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-1315

Presented is a new technique for obtaining useful approximate and exact solutions for problems associated with the determination of the natural frequencies, mode shapes and impulse response of a linear vibrating system. The fundamental concepts on which the technique is based are: (1) the use of inertia (mass) as a perturbation parameter for developing series solutions for the response of a system to harmonic excitation; and (2) the expansion of these series solutions as continued fractions. Lumped systems without damping are completely amenable to this method of solution, and a two-degree-of-freedom system with damping is solved. Approximate solutions for an axially loaded rod, a Timoshenko beam, and an Euler beam of variable cross-section illustrate the application of the method of analysis to continuous systems. Dissert. Abstr.

N68-25104*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PENETRATION RESISTANCE OF DOUBLE SHEET STRUCTURES AT VELOCITIES TO 8.8 KM/SEC
C. Robert Nysmith Washington May 1968 17 p refs
(NASA-TN-D-4568) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Small pyrex glass spheres were launched into aluminum double-sheet targets at velocities to 8.8 km/sec to determine the effects of total sheet thickness and sheet spacing upon penetration resistance. The ballistic limit of double-sheet structures consisting of two equally thick aluminum sheets was found to increase with increasing total sheet thickness and sheet spacing. In addition, for a particular ratio of total sheet thickness to projectile diameter, the effectiveness of sheet spacing increases with increasing impact velocity. The data indicate that for impacts at a given velocity the ratio of front-sheet thickness to projectile diameter that causes maximum vaporization or fragmentation or both will result in the most efficient meteor bumper. It is concluded that the double-sheet structure most efficient in resisting penetration will use that thickness for a front sheet and the remaining available mass in the rear sheet. Measurements were also made of the front-sheet hole diameter and the front-sheet mass loss. It was determined that the front-sheet hole diameter varies with the square root of the impact velocity and the 0.45 power of the front-sheet thickness and the front-sheet mass loss various with impact velocity and the square of the front-sheet thickness. Author

N68-25118 Arizona State Univ., Tempe.
DYNAMIC CHARACTERISTICS OF A SLENDER ELASTIC BODY OF VARIABLE MASS UNDER HIGH ACCELERATIONS
Donald Addison Wesley (Ph.D. Thesis) 1967 86 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-3210

The purpose of this investigation is to develop an understanding of the dynamic characteristics of a slender, elastic body of time-dependent mass subjected to high rectilinear accelerations. The analysis is applicable to a solid-fuel missile. Attention is devoted to the effect of combined rigid-body motion together with axial and lateral elastic motions. In addition, the effect of the internal fluid flowing relative to the vehicle case is investigated. Since the absolute position of the body in space is considered of lesser importance than the dynamic motions of the missile itself, body axes rather than inertial axes are utilized. Dissert. Abstr.

N68-25222*# Brown Engineering Co., Inc., Huntsville, Ala. Structures Dept.

PRESSURE TEST ANALYSIS OF 200-INCH MULTICELL TEST TANK

Murray F. Burnette and Rolland G. Sturm May 1968 16 p refs

(Contract NAS8-20073)

(NASA-CR-61221) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Pressure tests on a 200 inch multicell tank with waffle skin sections found the principle stresses parallel and perpendicular to waffle skin extrusions at mid-depth of the tank. Changes from a high theta angle reading at full loading to a low angle reading at higher pressure readings indicated that liquid weight effects are unimportant in this portion of the tank at high pressures. The magnitude of the stresses under liquid load alone was so small that reliable stress patterns could not be separated from total stress. It was concluded that the controlling stresses in this test tank are caused by stress concentrations and eccentricities. G.G.

N68-25259# Oak Ridge National Lab., Tenn. Chemical Technology Div.

STRUCTURAL ANALYSIS OF SHIPPING CASKS. VOLUME 6: IMPACT TESTING OF A LONG CYLINDRICAL LEAD-SHIELDED CASK MODEL

B. B. Klima, L. B. Shappert, and W. C. T. Stoddart Mar. 1968 36 p refs

(Contract W-7405-ENG-26)

(ORNL-TM-1312, V. 6) CFSTI: HC $3.00/MF $0.65

Settling of lead in lead-filled fissile and radioactive materials shipping casks due to impact was investigated. The cask testing facility is described. Results indicate that when an unbonded cylindrical cask is subjected to an impact, lead will move relative to the steel shell. A mathematical model is developed to quantitatively predict the magnitude of the lead movement. Data acquired during the testing of a smaller model confirms the applicability of this developed equation to predict lead movement in an unbonded cask. Author (NSA)

N68-25295*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

STUDY OF FLOW-INDUCED VIBRATIONS OF A PLATE IN NARROW CHANNELS

Samuel R. Bland, Richard H. Rhyne, and Harold B. Pierce 31 Mar. 1967 33 p refs Presented at the ASME Vibrations Conf., Boston, 29–31 Mar. 1967

(NASA-TM-X-59605) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Vibration phenomena associated with narrow channel flow have come under study as a result of the core failure of an early nuclear rocket engine. Since the mechanism of this vibration instability was not well understood at the time of failure, an investigation of a simple system consisting of a rigid plate with two degrees of spring restrained freedom in a two-dimensional channel has been made both experimentally and analytically. The results show a strong dependence of the flow rate required for plate oscillation on the channel width (normal to plate). Author

N68-25331*# Alabama Univ. Research Inst., Huntsville. Dept. of Engineering Mechanics.

NUMERICAL ANALYSIS OF NONLINEAR PNEUMATIC STRUCTURES

J. T. Oden and W. K. Kubitza 1967 47 p refs Presented at the Colloq. on Pneumatic Struct., Stuttgart, May 1967

(Grant NsG-381)

(NASA-CR-84721) CFSTI: HC $3.00/MF $0.65 CSCL 20K

This paper presents a systematic numerical procedure for the analysis of nonlinear behavior in general pneumatic structures. Recent advances in the application of the finite element method to the evaluation of finite strains and large displacements of elastic membranes are reviewed and extensions of the method to the analysis of large motions of reinforced fabrics, anisotropic metals, plastics, viscoelastic, and nonlinearly elastic materials are presented. Local yielding of metallic elasto-plastic membranes subjected to external pressure is also examined. By using linear displacement approximation and triangular finite elements, general nonlinear stiffness relations are derived. These lead to systems of nonlinear algebraic or ordinary differential equations in the generalized displacements and velocities which are solved numerically. Numerical results are included along with comparisons with available experimental data. Author

N68-25338*# Michigan Univ., Ann Arbor.

AEROELASTIC STABILITY OF PLATES AND CYLINDERS

William J. Anderson [1967] 22 p refs Presented at 4th Southeastern Conf. on Theoret. and Appl. Mech., 29 Feb. 1968

(Grant NGR-23-005-166)

(NASA-CR-89183) CSCL 20K

Linear stability criteria are presented for the panel flutter of thin plates and thin-walled cylinders. These structures are exposed to fluid flow passing parallel to an outer surface. The expression for fluid pressure is simplified in order to emphasize the dynamic properties of the systems. The analysis is intended to serve as an aid to understanding the mechanism of panel flutter. It is accurate for the static divergence and "coupled mode" flutter of flat panels in supersonic flow, and also for divergence problems wherever experimental measurements can supply the values for the necessary aerodynamic parameters. One result is to point out the importance of static instability for flat panels in a transonic viscous flow. A second result is to illustrate that the asymmetric divergence of cylindrical shells is very sensitive to small changes in the pressure distribution. Author

N68-25380*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FATIGUE OF STRUCTURAL MATERIALS SUITABLE FOR THE SUPERSONIC TRANSPORT

Herbert F. Hardrath [1967] 20 p refs Presented at the Symp. on Structural Mater. in the Environment of the Supersonic Transport, Los Angeles, 21–22 Feb. 1967, sponsored by AIME

(NASA-TM-X-59628) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The paper reviews some of the fatigue design considerations for the materials of the supersonic transport. Of particular interest are the effects of the load and temperature environments to be encountered during a desired life of 50,000 hours. Experimental work conducted at Langley to study behavior of candidate materials in fatigue tests, in crack propagation, in residual static strength, in out-door corrosion-fatigue tests, in programmed-load tests and others are cited as necessary to develop an assessment of the important parameters of the problem. Most of the Langley work has included thermal environments ranging from −110°F to 550°F; exposure times have ranged up to 3 years. While most of the data indicate that the effects of thermal exposure are negligible, some of the recent work indicates that beneficial effects of high load cycles on the subsequent fatigue behavior at lower loads can be decreased substantially by short-time exposure to elevated temperature. The need for continued research is indicated in order to allow a reliable design with a minimum of very costly testing. Author

N68-25387 Texas Univ., Austin.
LARGE DEFORMATIONS OF A CLAMPED EDGE THIN ELLIPTIC PLATE SUBJECT TO A CONTINUOUSLY VARYING, NORMAL SYMMETRIC LOADING
Irwin David Cooley (Ph.D. Thesis) 1966 187 p
Available from Univ. Microfilms: HC $8.60/MF $3.00 Order No. 67-3267

The problem of determining the deformations and stress and strain distributions for the nonlinear large deflection of a clamped-edge thin elliptic plate subject to a continuously varying distributed normal pressure is treated. The loading is symmetrical with respect to the semi-major and semi-minor axes of the ellipse and has the form of a general even-functioned finite power series in terms of the rectangular coordinates defining the undeformed middle surface of the plate. The special case of a general second degree load is extracted from the polynomial form of the general loading. This second degree loading then is further specialized to the case of an elliptic paraboloid having a maximum intensity at the center of the plate and vanishing on the boundary. The manner of obtaining the case of a zero degree (uniform) load from the second degree formulation is demonstrated. Results of the theoretical analysis for the elliptic paraboloidal loading are compared with experimental data obtained from tests on aluminum plates. Dissert. Abstr.

N68-25393 Washington State Univ., Pullman.
SHOCK WAVES IN STRESS-RELAXING SOLIDS
James Norman Johnson (Ph.D. Thesis) 1966 122 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-1563

From the theory of one-dimensional shock propagation in stress-relaxing solids we find that the rate-dependent properties are controlled by a relaxation function which depends on the stress, strain, and perhaps even on the past history of the specimen. When plastic flow is due to the motion of dislocations, the relaxation function can be calculated by knowing the density and velocity of mobile dislocations. The dislocation velocity is assumed to be a function of the applied shear stress alone, as given by Gilman and Johnston. To calculate the mobile dislocation density, we use two quite different models of dislocation multiplication. The first is the model given by Gilman in which multiple-cross-glide is assumed responsible for the creation of new dislocations, and the second is a model postulated by Band where the Frank–Read mechanism acts as line source of dislocations. By use of the von Neumann–Richtmyer artificial viscosity method, we then apply the basic theory to the problem of shock propagation in elastic–plastic-relaxing solids. In particular, we study the behavior of the relaxing elastic precursor in iron. A significant drop in pressure immediately behind the precursor front was observed by Taylor and Rice in their study of the dynamical properties of iron. Such a pressure drop is also observed from calculations with the artificial viscosity method when either Band's or Gilman's model of dislocation multiplication is used. Dissert. Abstr.

N68-25420 Pennsylvania State Univ., University Park.
TEMPERATURE COMPENSATION OF HELICAL SPRINGS BY THERMOMETAL ACTION
William August Kleinhenz (Ph.D. Thesis) 1966 231 p
Available from Univ. Microfilms: HC $10.60/MF $3.00 Order No. 67-1935

Helical springs composed of ordinary materials show a significant loss in stiffness at elevated temperatures due to a decrease in the modulus of rigidity with temperature. Of the possible approaches to the problem of thermal compensation, this paper deals with the use of a bimetal section helical compression spring in which the interface between the two metals is parallel to the spring axis. When the higher expansion alloy is located along the outside of the spring diameter, an increase in temperature in conjunction with differing alloy expansivity values causes a decrease in spring radius to offset the loss in material stiffness. An equation for thermal invariability of a thermometal spring relates the spring index to the thermal properties of the spring alloys and section geometry. Experimental results on the thermometal section helical compression spring (high expansion alloy—19.4 Ni, 2.25 Cr, 0.5 C, Bal Fe and low expansion alloy—38.65 Ni, Bal Fe) show a deviation in stiffness of less than 1-1/2% from 70° to 460°F. Dissert. Abstr.

N68-25421*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CRITICAL-SPEED ANALYSIS OF FLEXIBLY MOUNTED RIGID ROTORS
Richard H. Cavicchi Washington Jun. 1968 54 p refs
(NASA-TN-D-4807) CFSTI: HC $3.00/MF $0.65 CSCL 13I

A general solution of the frequency equation for rigid rotors in undamped bearings is derived for forward and backward precession. The solution is applied to a wide range of speeds and shapes, with variation in center-of-gravity location, to obtain maps of the frequency characteristics and locate major and nonsynchronous critical speeds. When the center of gravity is at the bearing centerline midpoint, a set of two solutions exists. An additional set of two solutions appears, however, when the center of gravity is away from this point. No forward-precession high-frequency critical speeds exist if the moment-of-inertia ratio equals or exceeds the critical-speed ratio. With the center of gravity midway between single-row ball bearings and the polar and diametral moments of inertia equal, a nonsynchronous critical speed exists at all rotor speeds. Author

N68-25434*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HANGING-CHAIN IMPACT DAMPERS: A SIMPLE METHOD FOR DAMPING TALL FLEXIBLE STRUCTURES
Wilmer H. Reed, III [1967] 41 p Presented at the Intern. Res. Seminar: Wind Effects on Buildings and Struct., Ottawa, 11–15 Sep. 1967
(NASA-TM-X-60522) CFSTI: HC $3.00/MF $0.65 CSCL 13M

This paper investigates a simple concept of achieving damping in order to suppress wind-induced oscillations of a class of erected structures such as antennas, stacks, and towers. It is shown that a chain, covered with a rubber sleeve and suspended with freedom to impact against a vertical channel, is capable of absorbing significant energy associated with transverse oscillations of the channel. The effects of various parameters on the performance characteristics of such a damper are determined experimentally in terms of mechanical impedance measurements. The experimental data are found to be in reasonable agreement with a simplified theory which is derived on the basis of a single-particle impact damper. Chain dampers installed on a 70-foot-tall erected launch vehicle increased the damping of the structure by a factor of up to 3. Results of this generalized research study indicate that the performance of hanging-chain impact dampers can be predicted with accuracy suitable for design purposes. Author

N68-25477# Naval Research Lab., Washington, D. C. The Shock and Vibration Information Center.
THE SHOCK AND VIBRATION BULLETIN, NO. 37, PART 7
Jan. 1968 255 p refs Papers presented at the 37th Symp. on Shock and Vibration, Orlando, Fla., 24–26 Oct. 1967
(AD-667230)

CONTENTS:

1. SURVEY OF THE CARGO-HANDLING SHOCK AND VIBRATION ENVIRONMENT F. E. Ostrem (Gen. Am. Transportation Corp.) p 1–17 refs (See N68-25478 14-32)

2. A NEW LOOK AT TRANSPORTATION VIBRATION STATISTICS J. W. Schlue and W. D. Phelps (JPL) p 19–37 ref (See N68-25479 14-32)

3. RECENT SHOCK AND VIBRATION MEASUREMENTS ON THE M-151 (JEEP) VEHICLE R. D. Brunnemer and G. M. Pomonik (Hughes Aircraft Co.) p 39–65 refs (See N68-25480 14-32)

4. LATERAL IMPACT SHOCK DURING SHIP LOADING OF THE A3 POLARIS MISSILE E. G. Fischer, C. R. Brown, and A. J. Molnar (Westinghouse Elec. Corp.) p 67–75 refs (See N68-25481 14-32)

5. EMPIRICAL CORRELATION OF FLIGHT VEHICLE VIBRATION RESPONSE W. H. Roberts (Martin Co.) p 77–91 refs (See N68-25482 14-32)

6. VIBRATION DATA SUMMARY OF MINUTEMAN WING VI FLIGHT TEST MISSILES R. R. Burnett and R. E. Morse (TRW Sys.) p 93–172 ref (See N68-25483 14-32)

7. SPACECRAFT VIBRATION: A COMPARISON OF FLIGHT DATA AND GROUND TEST DATA G. Kachadourian (GE) p 173–203 (See N68-25484 14-32)

8. MEASUREMENT AND ANALYSIS OF GUN FIRING AND VIBRATION ENVIRONMENTS OF THE RIVER PATROL BOAT R. S. Reed (Naval Ordnance Lab.) p 205–220 refs (See N68-25485 14-32)

9. SCALE-MODEL WIND-TUNNEL ACOUSTIC DATA J. R. Baratono and F. A. Smith (Martin Co.) p 221–252 refs (See N68-25486 14-01)

N68-25478*# General American Transportation Corp., Niles, Ill. Research Div.
SURVEY OF THE CARGO-HANDLING SHOCK AND VIBRATION ENVIRONMENT
F. E. Ostrem *In* NRL The Shock and Vibration Bull., No. 37, Pt. 7 Jan. 1968 p 1–17 refs (See N68-25477 14-32)
(Contract NAS8-11451) CSCL 20K

A comprehensive literature survey and search was conducted for data and information applicable to the cargo-handling shock and vibration environment. The information compiled is summarized to show the various forms of the available data; where drop height data are available they are presented to show the distribution of drop heights for particular packages, distribution systems, and handling operations. Other information is also presented on the handling environment, such as the number of drops received per package per trip, the distribution of the drops over the faces, edges, and corners, the effect of package size and weight, the effect of the distribution, and the effect of labels and handholds. A case history for paper sacks, which describes the complete drop height history from manufacturer to customer, is also presented. Author

N68-25479*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A NEW LOOK AT TRANSPORTATION VIBRATION STATISTICS
John W. Schlue and William D. Phelps *In* NRL The Shock and Vibration Bull. No. 37, Pt. 7 Jan. 1968 p 19–37 ref (See N68-25477 14-32)
(Contract NAS7-100) CSCL 20K

Amplitude statistics of vibration data measured on the floor of air-ride suspension vans and airplanes are presented in this report. Power spectral density plots of the vibration are also included. Evidence supporting the qualification of vans prior to their use is shown and discussed. Author

N68-25480# Hughes Aircraft Co., Canoga Park, Calif.
RECENT SHOCK AND VIBRATION MEASUREMENTS ON THE M-151 (JEEP) VEHICLE
Ronald D. Brunnemer and George M. Pomonik *In* NRL The Shock and Vibration Bull., No. 37, Pt. 7 Jan. 1968 p 39–65 refs (See N68-25477 14-32)

A test program and data acquired during a field test conducted to measure shock and vibration environment for the TOW weapon system as mounted on the M-151 vehicle (jeep) are described. Test conditions included operation over various road surfaces from smooth to unimproved, over cross-country terrain, and over a Munson-type road course. Instrumentation consisted of piezoelectric accelerometers with charge amplifiers for signal conditioning and a portable (14-track) magnetic tape recorder. Examination of the data leads to the conclusion that the vibration environment is no more severe than that specified in "Vibration test curve for equipment installed in ground vehicles." Author

N68-25481# Westinghouse Electric Corp., Pittsburgh, Pa.
LATERAL IMPACT SHOCK DURING SHIP LOADING OF THE A3 POLARIS MISSILE
E. G. Fischer, C. R. Brown, and A. J. Molnar *In* NRL The Shock and Vibration Bull., No. 37, Pt. 7 Jan. 1968 p 67–75 refs (See N68-25477 14-32)

Lagrange's equations have been used to predict the large-angle, double-pendulum type of motion observed when the A3 Polaris missile-liner system is subjected to lateral impact shock during transfer from supply ship to submarine. Modal vibration effects for the flexible missile-liner combination are superimposed on the rigid body solution of the problem. In addition, lateral shock tests have been made on a full-scale A3 missile test vehicle, using a crane and barge simulation. Author

N68-25482# Martin Co., Orlando, Fla.
EMPIRICAL CORRELATION OF FLIGHT VEHICLE VIBRATION RESPONSE
W. H. Roberts *In* NRL The Shock and Vibration Bull., No. 37, Pt. 7 Jan. 1968 p 77–91 refs (See N68-25477 14-32)
(Contract AF 33(657)-8218)

Objective of the study was correlating flight vehicle vibration response with the excitation and flight operating conditions. Emphasis was on study of local dynamic properties. The value of the method was demonstrated in this study, where the errors between measured and predicted values averaged a factor of 1.5, or ±3.5 db, a considerable advance over previous correlations. Influence of the variations in configuration is apparent in the data. The major flight environment and source of vehicle structural vibration is jet turbulence on jet aircraft at subsonic speeds. A major change takes place in the flight regime for vehicle velocities greater than sonic. The principal exciters are lost and lesser ones remain. The only exceptions to expectations of lower environments and responses occur with (a) vehicles whose aerodynamic contours are poor, and (b) vehicles whose propulsion systems generate high oscillatory thrust components. With few exceptions the flight vibration levels encountered were low. A study of the local responses in a compartment of the SM62 (Snark) leads to a basic correlation where the important parameters are circumferential attenuation and local mass. The standard deviation for this study was small, ±2.65 db, or a factor of 1.36. Author

N68-25483# TRW Systems, Redondo Beach, Calif.
VIBRATION DATA SUMMARY OF MINUTEMAN WING 6 FLIGHT TEST MISSILES
Robert R. Burnett and Robert E. Morse *In* NRL The Shock and Vibration Bull., No. 37, Pt. 7 Jan. 1968 p 93–172 ref (See N68-25477 14-32)

Vibration data reduced by TRW Systems from 15 Minuteman Wing VI flight test missiles and 3 test missiles from a special flight test program are summarized. Included are data from measurement locations throughout the missile. Vibration instrumentation, equipment configuration and data analysis techniques are outlined. Profiles of the rms vibration as a function of flight time, as well as PSD analyses, are included when applicable. These data are used to (a) verify the estimated environment used to derive dynamic test specifications; (b) measure the vibration along a transmission path for use in determining modes and transfer functions; (c) measure the response of equipment on structures to the vibration environment; (d) aid in guidance error analysis; (e) extrapolate to later Munuteman Wing environments; (f) establish structure load criteria; and (g) aid in flight failure analyses. Author

N68-25484# General Electric Co., Philadelphia, Pa.
SPACECRAFT VIBRATION: A COMPARISON OF FLIGHT DATA AND GROUND TEST DATA
G. Kachadourian *In* NRL The Shock and Vibration Bull., No. 37, Pt. 7 Jan. 1968 p 173–203 (See N68-25477 14-32)

There has been a continuing accumulation of flight vibration data throughout the industry from measurements on space flight systems. Comparison of these data and the vibration procedures used in qualification testing of systems and components has shown that these procedures generally do not duplicate flight conditions adequately and that overtesting and undertesting is encountered. The differences between flight vibration environments and ground test vibrations by the use of a specific space system are investigated to develop improved systems and component testing procedures. These results are extended to cover spacecraft in general. Details of the flight measurements, including sensor mounting details, time histories, and power spectral densities, are presented. Nonstationarity of the data is discussed, and a method for correcting the PSD plots for nonstationarity is applied. Details of ground test measurements on an identical system are presented, discussed, and compared with the flight data. The importance of sensor locations is graphically illustrated, and the importance of categorizing vibration data according to sensor location and mounting is emphasized. Author

N68-25485# Naval Ordnance Lab., White Oak, Md.
MEASUREMENT AND ANALYSIS OF GUN FIRING AND VIBRATION ENVIRONMENTS ON THE RIVER PATROL BOAT
R. S. Reed *In* NRL The Shock and Vibration Bull., No. 37, Pt. 7 Jan. 1968 p 205–220 refs (See N68-25477 14-32)

The River Patrol Boat (PBR) is a 30-ft, dual-engine, fiber-glass boat which uses a pump propulsion system. The vibration environment was measured at seven locations, chosen because they were present or proposed weapon mounting locations or because they were logical storage locations. The measurements were made under conditions which included high speed, medium speed, bow slap (condition created by turning into the wake), and gun firing. The data were analyzed using a general purpose digital computer to determine power spectra, amplitude distribution, and shock spectra (when appropriate). In general, the analyses indicated that most of the vibration energy was below 400 Hz and that overall acceleration levels ranged from 0.07 to 0.86 g rms (excluding the firing data). The amplitide distributions had Gaussian forms. The transient firing data had peaks as high as 23 g; the major shock spectrum peaks occurred at 1500 Hz and were in the 50- to 100-g range. Author

N68-25498# Naval Research Lab., Washington, D. C. The Shock and Vibration Information Center.
THE SHOCK AND VIBRATION BULLETIN
Jan. 1968 235 p refs Presented at the 37th Symp. on Shock and Vibration, Orlando, Fla., 24–26 Oct. 1967 *Its* Bull. No. 37, Pt. 3
(AD-667228)

CONTENTS:

1. ADVANCES IN NUMEROLOGY J. P. Salter (Roy. Armament Res. and Develop. Estab.) p 1–6 refs (See N68-25499 14-32)

2. INTERNAL VIBRATION OF ELECTRONIC EQUIPMENT RESULTING FROM ACOUSTIC AND SHAKER-INDUCED EXCITATION A. D. Houston (Lockheed Missiles and Space Co.) p 7–20 (See N68-25500 14-32)

3. RANDOM-VIBRATION RESPONSE DATA FOR ORBITING GEOPHYSICAL OBSERVATORY: FLIGHT, ACOUSTIC, AND VIBRATION TEST W. G. Elsan (NASA Goddard Space Flight Center) p 21–45 refs (See N68-25501 14-32)

4. RANDOM-VIBRATION TEST LEVEL CONTROL USING INPUT AND TEST ITEM RESPONSE SPECTRA A. J. Curtis and J. G. Herrera (Hughes Aircraft Co.) p 47–60 refs (See N68-25502 14-32)

5. RANDOM-FORCE VIBRATION TESTING J. V. Otts and N. F. Hunter, Jr. (Sandia Corp.) p 61–74 refs (See N68-25503 14-32)

6. CONTROL POINT AVERAGING FOR LARGE SPECIMEN VIBRATION TESTS H. R. Berkman (Litton Systems, Inc.) p 75–88 refs (See N68-25504 14-32)

7. VIBRATION METHODS FOR MULTIPLE RANDOM EXCITATION W. E. Noonan (McDonnell Aircraft Corp.) p 89–97 refs (See N68-25505 14-32)

8. DYNAMIC TESTING OF FULL-SCALE SATURN LAUNCH VEHICLES B. R. Jacobs (Northrop Corp.) p 99–120 refs (See N68-25506 14-32)

9. BUFFET RESPONSE MEASUREMENTS OF A SEVEN PERCENT AEROELASTICALLY SCALED MODEL OF VARIOUS TITAN III CONFIGURATIONS J. T. Uchiyama and F. W. Peters (Martin Co.) p 121–136 refs (See N68-25507 14-32)

10. HIGH-FORCE VIBRATION TESTING OF THE SATURN S-IVB STAGE L. G. Smith (McDonnell Aircraft Corp.) p 137–149 ref (See N68-25508 14-32)

11. SIMPLIFIED METHOD OF CONDUCTING A DUAL RANDOM-VIBRATION INTEGRATED SYSTEM TEST J. G. Colt (RCA) p 151–154 (See N68-24409 14-32)

12. CONTROL STABILIZATION FOR MULTIPLE SHAKER TESTS N. F. Hunter, Jr. (Sandia Corp.) and J. G. Helmuth (Chadwick-Helmuth Co.) p 155–162 refs (See N68-25510 14-32)

13. THE SHIM SPRING ISOLATOR L. Wallerstein, Jr. (Lord Mfg. Co.) p 163–173 refs (See N68-25511 14-15)

14. ADVANCED COMBINED ENVIRONMENTAL TEST FACILITY E. J. Rirchman and C. J. Arcilesi (NASA Goddard Space Flight Center) p 175–192 refs (See N68-25512 14-11)

15. DEVELOPMENT OF SIMULATED AIRCRAFT DELIVERY USING A ROCKET SLED W. R. Kampfe and K. M. Timmerman (Sandia Corp.) p 193–201 (See N68-25513 14-11)

16. AERODYNAMIC NOISE INVESTIGATION IN A SHORT-DURATION SHOCK TUNNEL D. H. Ross (Aerospace Cop.) p 203–217 refs (See N68-25514 14-01)

17. IMPACT TESTING WITH A FOUR-INCH AIR GUN AND LEAD TARGETS H. J. Davis (HDL) p 219–231 refs (See N68-25515 14-32)

N68-25499# Royal Armament Research and Development Establishment, Fort Halstead (England).
ADVANCES IN NUMEROLOGY
J. P. Salter *In* NRL The Shock and Vibration Bull. Jan. 1968 p 1–6 refs (See N68-25498 14-32)

The fundamental basis of vibration testing is discussed, with particular emphasis on the arbitrary and misleading nature of specifications, the difficulty of generating and measuring test forces, and the errors resulting from an attempt to attain consistency. The realities of shock and vibration are untidy, complex, and incommensurable. In the author's view the attempt to use precise, defined numerical values to represent these realities is itself unrealistic. The use of simpler and more empirical techniques is urged, and two simple examples are given. Author

N68-25500# Lockheed Missiles and Space Co., Sunnyvale, Calif.
INTERNAL VIBRATION OF ELECTRONIC EQUIPMENT RESULTING FROM ACOUSTIC AND SHAKER-INDUCED EXCITATION
Allan D. Houston *In* NRL The Shock and Vibration Bull. Jan. 1968 p 7–20 (See N68-25498 14-32)

Reported are results of empirical studies of the nature of vibration environments existing within electronic equipment. The primary objectives of the studies were: (1) to determine whether estimated vibrations responses within equipment during flight are compatible with vibration test criteria of electronic piece parts; (2) to investigate the validity of shaker excitation techniques in simulating flight-type acoustically induced environments; and (3) to

evaluate the effectiveness of viscoelastic fabrication materials in reducing responses within equipment. A series of reverberant chamber acoustic tests were conducted on a 60 in. diameter cylindrical airframe containing internal support structure with several packages of electronic equipment attached to it. Experimental objectives were to measure absolute response of elements within the package and also to obtain transmissibility data between internal and external package environments. Another package was specially fabricated and tested to compare viscoelastic vibration attenuation materials with existing fabrication materials. The second phase of the experimental work was conducted using shaker excitation techniques on a number of packages evaluated during the acoustic test. Results indicated that: (1) shaker induced vibration of equipment produced responses of elements within equipment from 2 to 10 times more severe than those produced by an acoustically induced excitation when the equipment is installed on launch vehicle structure; (2) environments measured within equipment differ in form from those used in qualification tests of electronic piece parts, such as electromagnetic relays; and (3) sparse use of viscoelastic materials within a package resulted in a 20 to 35 percent reduction of vibration transmissibilities, as measured between package mounts and internal structure. Author

N68-25501*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

RANDOM-VIBRATION RESPONSE DATA FOR ORBITING GEOPHYSICAL OBSERVATORY: FLIGHT, ACOUSTIC, AND VIBRATION TEST

William G. Elsen *In* NRL The Shock and Vibration Bull. Jan. 1968 p 21–45 refs (See N68-25498 14-32) CSCL 20K

Random vibration response data for the Orbiting Geophysical Observatory are avilable from three sources: launch phase of flight spacecraft, acoustic test, and random vibration test. Reported is a study designed to determine how well ground tests (acoustic and vibration) can duplicate the actual flight random environment, and how well a random vibration test can simulate an acoustic test. Results indicated that: (1) an acoustic test can produce a good duplication of the flight environment if the basic input acoustic spectrum is modified to compensate for facility peculiarities and unrealistic boundary conditions; and (2) a random vibration test can be a fairly good simulation of an acoustic test. However there are other drawbacks of a vibration test: energy transmission paths are unrealistic; energy is introduced into the spacecraft only one axis at a time; and to get a sufficiently high level of vibration into many parts of the spacecraft, it is necessary to input a considerable amount of energy at the base of the spacecraft. In view of serious limitations of random vibration tests, it is concluded that an acoustic test is still the best simulation of the random vibration portion of the flight environment and should be performed where possible instead of a random vibration test. Author

N68-25502# Hughes Aircraft Co., Culver City, Calif.

RANDOM-VIBRATION TEST LEVEL CONTROL USING INPUT AND TEST ITEM RESPONSE SPECTRA

A. J. Curtis and J. G. Herrera *In* NRL The Shock and Vibration Bull. Jan. 1968 p 47–60 refs (See N68-25498 14-32)

Testing which simulates the predicted aircraft flight vibration environment for an equipment rack or assembly made up of a number of black boxes plus the supporting rack structure is discussed. The rack may be considered an extension of the aircraft structure, and the vibration level is defined at the attachment points of the individual units to the rack, and possibly at the attachments of the rack to the aircraft. To a reasonable approximation, the center frequencies of the narrow-band spikes which occur at unit attachment points are defined by the transmission characteristics of the loaded rack structure. Therefore a test method has been devised in which the control of the vibration level uses both the input spectrum, defined by the power average of the acceleration at the assembly attachment points, and the response spectra, measured at the attachment points of the individual units. The impedance characteristics of the equipment are empirically accounted for by allowing a resonant response within the assembly to force a notch in the spectrum at the attachment points. The method of implementing an assembly test using input and response control is described. The use of hybrid analog-digital spectral analyzer, with further use of the digital portion for computation of the shaped input spectrum for each iteration, is also described. The results of using this method on an air to air guided missile are presented. Author

N68-25503# Sandia Corp., Albuquerque, N. Mex.

RANDOM-FORCE VIBRATION TESTING

John V. Otts and Norman F. Hunter, Jr. *In* NRL The Shock and Vibration Bull. Jan. 1968 p 61–74 refs Sponsored by AEC (See N68-25498 14-32)

A study designed to develop the capabilities for accurate and economical testing in the area of random force vibration is reported. Presented are results of studies focusing on: (1) random vibration response predictions; (2) W_A (apparent weight) measurement with random force and acceleration data; and (3) W_A simulation through electronics during force controlled vibration tests. S.C.W.

N68-25504# Litton Systems, Inc., Van Nuys, Calif.

CONTROL POINT AVERAGING FOR LARGE SPECIMEN VIBRATION TESTS

Herbert R. Berkman *In* NRL The Shock and Vibration Bull. Jan. 1968 p 75–88 refs (See N68-25498 14-32)

Vibration tests currently being performed on a large computer programmer employ an averaging system for input control. The effectiveness of this system in conjunction with a large test fixture has been evaluated through preliminary tests with a mockup specimen. Arguments are presented in favor of the averaging concept as a valid test method, with emphasis on defining new terminology to relate specified vibration levels directly to the averaged control level. Data acquired in the tests is presented in a manner particularly suited for averaged control and is used to emphasize the difficulty in applying a specified environment uniformly in a large package test. A system of defining the range of variation allowable between the averaged control points is presented and directly related to a proposed new tolerance term which, if incorporated into future specifications or amended to present ones, would allow averaging to become more universally acceptable. Author

N68-25505# McDonnell Aircraft Corp., St. Louis, Mo.

VIBRATION METHODS FOR MULTIPLE RANDOM EXCITATION

William E. Noonan *In* NRL The Shock and Vibration Bull. Jan. 1968 p 89–97 refs (See N68-25498 14-32)

An investigation was conducted to establish a method, through applications of impedance techniques, for controlling a random environment resulting from multiple excitation. The output power spectral density (PSD) of a linear system was expressed in terms of system functions, input PSD's, and their cross PSD's. A theoretical model was constructed, and the most simple multiple system (two degrees of freedom) was selected. The system response was determined, and the effects of uncorrelated and correlated forcing functions demonstrated. A result of this investigation revealed that arbitrary output PSD's cannot be obtained for independent applied sources. Arbitrary output spectra can impose a negative energy requirement on independent sources. Experimental tests were conducted on a free-free beam. System functions were obtained through sinusoidal tests and were used in predicting the random response. The only independent parameter in the experimental system was the power amplifier input voltages. Random tests, conducted for uncorrelated power amplifier input voltages, resulted in good correlation between predicted and measured response. Using the results of the theoretical and experimental investigations, a proposed test method is described for multiple random excitation. Author

N68-25506# Northrop Corp., Huntsville, Ala. Nortronics Div.
DYNAMIC TESTING OF FULL-SCALE SATURN LAUNCH VEHICLES
B. R. Jacobs *In* NRL The Shock and Vibration Bull. Jan. 1968 p 99–120 refs (See N68-25498 14-32)

A history of dynamic testing of full scale Saturn launch vehicles at Marshall Space Flight Center is given. Methods and procedures, as well as instrumentation and facilities, are reviewed. The uses of full scale tests are discussed, with a brief look at the uses of geometrically scaled models. Full scale test results are compared with model test results, flight data, and mathematical models. Author

N68-25507# Martin Co., Denver, Colo.
BUFFET RESPONSE MEASUREMENTS OF A SEVEN PERCENT AEROELASTICALLY SCALED MODEL OF VARIOUS TITAN 3 CONFIGURATIONS
Jerome T. Uchiyama and Frank W. Peters *In* NRL The Shock and Vibration Bull. Jan 1968 p 121–136 refs (See N68-25498 14-32)

Presented are results of buffet response test measurements of 7 percent aeroelastically scaled models of three basic Titan III configurations with various payloads which were made in the 16 ft transonic propulsion wind tunnel facility. Measurements were taken of the bending moment response to buffet at various locations along the vehicle over a Mach number range of 0.6 through 1.4. The effect of variation of pitch angle of attack and dynamic pressure upon bending moment response was studied. Tested were: (1) single body Titan IIIA; (2) three body basic Titan III with five segment rocket motors; and (3) three body Titan III with seven to one-half segment solid rocket motors. It was found that: (1) peak buffet response occurs at subsonic Mach numbers; (2) the Titan IIIA single body configuration produces very low buffet loading; (3) large diameter bulbous payloads with blunt noses and L/D ratios less than 1.0 will produce excessive buffet loading (Voyager payload); (4) excessive buffet loading obtained on the Voyager payload configuration can be reduced to reasonable levels by increasing the L/D ratio to greater than 1.0 by the addition of a shroud with the same diameter as the payload; and (5) Titan IIIC configurations with 5, 7, or 7 to one-half segment SRM's and standard nose fairings do not produce excessive buffet loading. S.C.W.

N68-25508*# Douglas Aircraft Co., Inc., Huntington Beach, Calif.
HIGH-FORCE VIBRATION TESTING OF THE SATURN S-IVB STAGE
L. G. Smith *In* NRL The Shock and Vibration Bull. Jan. 1968 p 137–149 ref (See N68-25498 14-32)
(Contract NAS7-101) CSCL 22D

In testing the Saturn I instrument unit, large strains induced by low frequency modal behavior caused structural failures at points undetected during qualification testing of detail assemblies. To ensure the structural integrity of the Saturn V launch vehicle, high force dynamic tests were performed on subassemblies of their respective stages. High force vibration testing of two large subassemblies of the S-IVB stage is described. Included are program management, test specimens, test fixtures, test criteria, test control, test data systems, and test results.

N68-25509# Radio Corp. of America, Burlington, Mass.
SIMPLIFIED METHOD OF CONDUCTING A DUAL RANDOM VIBRATION INTEGRATED SYSTEM TEST
James G. Colt *In* NRL The Shock and Vibration Bull. Jan. 1968 p 151–154 (See N68-25498 14-32)

An integrated random vibration/electrical performance test method which was used to demonstrate the performance of a rendezvous radar antenna and electronics assemblies during vibration is described. Two separate vibration systems were used: one to vibrate the antenna assembly at one random spectrum, and the other to vibrate the electronics assembly at another random spectrum. The feasibility of vibrating both assemblies simultaneously using separate shaped random inputs was demonstrated using the two vibration exciters, one random console, and one magnetic tape recorder with a prerecorded spectrum signal on tape replacing the second random console. A description of the facilities used is included. S.C.W.

N68-25510# Sandia Corp., Albuquerque, N. Mex.
CONTROL STABILIZATION FOR MULTIPLE SHAKER TESTS
Norman F. Hunter, Jr. and James G. Helmuth (Chadwick-Helmuth Co.) *In* NRL The Shock and Vibration Bull. Jan. 1968 p 155–162 refs Supported by AEC (See N68-25498 14-32)

Large test specimens often require multiple shaker excitation for realistic simulation of field vibration levels. At some frequencies, energy crossfeed between shakers causes control problems. Until recently no methods existed for controlling multiple shaker tests at frequencies where the specimen exhibited cross coupling factors (CCF) in excess of about unity. A method for controlling any number of shakers with CCF >1 is described. Author

N68-25515# Harry Diamond Labs., Washington, D. C.
IMPACT TESTING WITH A FOUR-INCH AIR GUN AND LEAD TARGETS
Harry J. Davis *In* NRL The Shock and Vibration Bull. Jan. 1968 p 219–231 refs (See N68-25498 14-32)

Fuses and fuse components are tested for ruggedness by mounting them in projectiles and firing them from an air gun into lead blocks. An evaluation of this method of testing is reported. The air gun is 96 ft long and has a 4-in bore. The projectile is 11 in long, has a round nose, and with a standard fuse cargo weighs 17.5 lb. The muzzle velocity of this projectile ranges from 100 to 650 fps. The target consists of 3 to 10 lead blocks, each of which is 6 by 8 by 1 in. The deceleration of the projectile upon striking this target provides the test. The measured quantity of primary interest was the peak acceleration obtained from copper ball accelerometers. The advantages and disadvantages of copper ball accelerometers are discussed. Measurements indicate that structures or components with natural frequencies of hundreds of hertz experience 5000 to 50,000 g. Accelerations of the order of hundreds of thousands of g's, however, have been measured at natural frequencies greater than 10 kHz. Such measurements may differ by a factor of 2 at different points within the projectile. The air gun design and the test technique are discussed briefly. Target penetration phenomena are also discussed. The usual law which assumes a constant retarding force and the Poncelet solid penetration law are applied to the present study. It is concluded that, although the impact test is convenient and inexpensive means of subjecting fuses to high force levels, quantitative interpretation of the results must be made with caution. Author

N68-25525# Naval Research Lab., Washington, D. C. The Shock and Vibration Information Center.
THE SHOCK AND VIBRATION BULLETIN, NO. 37, PART 4
Jan. 1968 219 p refs Papers presented at the 37th Symp. on Shock and Vibration, Orlando, Fla., 24–26 Oct. 1967
(AD-667229)

Various aspects of shock analysis and simulation methods, and air blast and ground shock phenomena are treated in the reports presented. For individual titles, see N68-25526 through N68-25548.

N68-25526*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MEASUREMENT AND ANALYSIS OF SPACECRAFT SEPARATION TRANSIENT RESPONSE FOR MARINER-TYPE SPACECRAFT
Phillip Barnett *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 1–13 ref (See N68-25525 14-32)
(Contract NAS7-100) CSCL 22B

The Mariner spacecraft separation transient event and the efforts of the Jet Propulsion Laboratory to design ground tests for this event for both proof test model and flight spacecraft are described. A test program is described for measuring and evaluating the structural response of the spacecraft for the separation transient event is presented. Measured spacecraft acceleration transient response data in the form of time histories, shock spectra, and Fourier transforms are presented for a series of ground tests of pyrotechnically initiated spacecraft V-band separation events. Conclusions are drawn pertaining to the relative magnitude of the spacecraft transient response parameters for the range of V-band tensions used during the test program and to the feasibility of generating proof test model and flight spacecraft ground tests for this event. Instrumentation, data acquisition, and data handling techniques are briefly discussed. Author

N68-25527# North American Rockwell Corp., Los Angeles, Calif.
MECHANICAL SHOCK OF HONEYCOMB STRUCTURE FROM PYROTECHNIC SEPARATION
J. R. Olsen, J. R. West, Jr., H. Himelblau, C. D. Knauer (Hughes Aircraft Co., El Segundo, Calif.), and P. E. McHorney, Jr. (Hughes Aircraft Co., El Segundo, Calif.) *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 15–42 refs Prepared jointly with Hughes Aircraft Co., El Segundo, Calif. (See N68-25525 14-32)

Mechanical shock was measured at various locations on a half section of the Apollo service module, a structure of mainly honeycomb construction. The shock was generated by twin strands of mild detonating fuse which simulated the separation of the service module from the spacecraft/lunar-module adapter. Shock (or response) spectra of approximately 10,000 g were measured in the vicinity of the separation line. There was not as much attenuation with distance from the separation line as that reported previously for conventional sheet stringer construction. The structure, the test program, data acquisition, data reduction, and shock spectral analyses are described. Author

N68-25528# Allied Research Associates, Inc., Concord, Mass.
SIMPLE STRENGTH CONCEPT FOR DEFINING PRACTICAL HIGH-FREQUENCY LIMITS OF SHOCK SPECTRUM ANALYSIS
M. Gertel and R. Holland *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 43–57 refs (See N68-25525 14-32)
(Contract DA-36-038-AMC-4295(A))

Simple analyses have been conducted to define the shock spectrum equivalent static accelerations necessary to produce yield stress in idealized cantilever and pin-ended beam structures as a function of their normal mode frequencies and deflections. The accelerations to produce yielding failure are based upon a superposition of the maximum stresses at a common point for all modes, including correction for modal participation factors. Simple summary plots defining the failure acceleration required for yielding are presented for families of uniform cantilever and simply supported beams as a function of material, dimensions, and modal frequencies. It is seen from these plots that beams with high natural frequencies are inherently stronger than low frequency beams and require proportionately greater acceleration to cause yielding failure. A concept for utilizing these plots in conjunction with the peak acceleration of a given shock motion is presented for defining the upper frequency limit of shock spectrum analysis. Author

N68-25529# Boeing Co., New Orleans, La.
TRANSIENT VIBRATION SIMULATION
Thomas E. Fitzgerald and Louis C. Kula *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 59–63 ref (See N68-25525 14-32)

During the reliability test program of the S-IC stage of the Saturn V vehicle, certain critical system components were subjected to simulation of the transient vibrations that occur during the engine shutdown phase of static firings. Originally, the simulation consisted of a rapidly scanned sinusoidal sweep; however, it became apparent that this method did not truly simulate the engine shutdown phenomena since overly destructive resonance response levels were attained during the scan. As a result, a short duration, high intensity shaped random vibration test was devised. Reported are results of studies using the new technique. Results indicated that the short duration, high intensity shaped random vibration test should be used to replace the sinusoidal sweep test where applicable, because of the relative simplicity of the test and its many advantages. Primary advantages of the technique were: (1) the simulated random environment closely duplicated the true environment because vibration motion was fundamentally of a Gaussian nature, and this provided a reasonably similar amplification of the test specimen response and a realistic number high energy fatigue cycles; and (2) the overdesign of a specimen, normally to meet requirements of the sinusoidal sweep test, would be unnecessary. S.C.W.

N68-25530# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
PREDICTING MECHANICAL SHOCK TRANSMISSION
Jerome E. Manning and Kyung Lee *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 65–70 refs (See N68-25525 14-32)

Described is an energy flow method for use in mechanical shock transmission analyses. The method allows treatment of cases where shock loading establishes resonant, high frequency ringing; and yields a time history of the vibratory energy in various regions of a structure. The energy stored in a region of a structure can be used to estimate the average vibration level in that region. Major problems of the proposed method which arise when trying to calculate the coupling factors which govern the rate of energy flow between subsystems are discussed. The method was used to obtain predictions for an aerospace vehicle subjected to a pyrotechnic shock. Agreement between theory and experiment was satisfactory. S.C.W.

N68-25531# Naval Ship Research and Development Center, Portsmouth, Va.
SHOCK DAMAGE MECHANISM OF A SIMPLE STRUCTURE
Lowell T. Butt *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 71–77 Refs Sponsored in part by DASA (See N68-25525 14-32)

Two sets of four cantilever beams loaded with tip masses were mounted on the floating shock platform and shocktested by underwater explosions. These simple mechanical models were designed to undergo appreciable plastic deformations. Three analytical approaches to predict shock damage were applied to these beam mass models: (a) one considering elastic, perfectly plastic mode response; (b) another considering an energy balance to predict displacement bounds; and (c) the third considering an inelastic deformation mode approximation. The displacement bound and mode approximation methods were applied considering both elastic, perfectly plastic and rigid, perfectly plastic deformations. The analytical results were compared with experimental data. The elastic, perfectly plastic analysis shows good agreement with experiment up to the initial peak displacement. Computed elastic-plastic bounds and inelastic mode approximations also provide good estimations of the initial displacements. Author

N68-25532# Naval Ship Research and Development Center, Washington, D. C.
GENERAL MOTORS ENERGY-ABSORBING STEERING COLUMN AS A COMPONENT OF SHIPBOARD PERSONNEL PROTECTION
Jackson T. Hawkins and Arthur E. Hirsch *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 79–84 refs (See N68-25525 14-32)

Results of tests conducted to evaluate the potential of a proposed energy absorbing steering column for application in a system of protection for shipboard personnel subjected to underwater explosion attack are reported. The object of the tests was to determine the force transmitting characteristics of the columns, both singly and in multicolumn configurations, during shock loading similar to that which might be experienced at shipboard duty station. Results indicated that: (1) pedestals composed to integral numbers of the collapsable section of energy absorbing steering columns have force limiting capabilities which meet protection requirements of personnel subjected to ship motions from underwater explosion attack; (2) the high stroke thickness ratio of this device permits its effective application for protection in low head room areas, and in this respect it is the most efficient device yet investigated; and (3) ease of procurement, low cost, simplicity, durability, and consistent and desirable shock absorbing characteristics make this a most attractive device for incorporation into personnel shock protection equipment. S.C.W.

N68-25534# Westinghouse Electric Corp., Lester, Pa.
DERIVATION AND IMPLICATIONS OF THE NAVY SHOCK ANALYSIS METHOD
F. J. Heymann *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 91–95 ref (See N68-25525 14-32)

The working equations of the Belsheim–O'Hara dynamic analysis method are developed nonrigorously, with a minimum of mathematics, on the basis of physical and logical reasoning. The expressions for modal equivalent (or effective) mass, equivalent displacement, and shock response of system masses are derived using no postulates other than (1) a definition of dynamic equivalence between vibratory modes of different systems; (2) the assumption that system modes of equal frequencies and equal equivalent masses will respond to the same shock condition at levels consistent with dynamic equivalence; and (3) the requirement that the responses of arbitrary single degree of freedom systems be known, as from test data. The concept of equivalent displacement ratios is preferred to that of the more commonly used participation factors; the former are shown to be fixed quantities for a given system mode, whereas the latter are not. This approach reveals clearly that the method is not predicated upon any particular shape or nature of the shock input to the system (such as a step velocity input) and can yield no information about the initial phase relationships between the various modes. Since in a real system the responses also decay rapidly, it follows that there is an inherent difficulty, in this method, of summing the effects of the various modes without being overly conservative. Author

N68-25535# Kaman AviDyne, Burlington, Mass.
DYNAMIC ANALYSIS OF A TYPICAL ELECTRONIC EQUIPMENT CABINET SUBJECTED TO NUCLEAR-WEAPON-INDUCED SHOCK
John H. Putukian *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 97–101 refs (See N68-25525 14-32)

The response to nuclear weapon effects of sensitive electronic components housed in equipment cabinets on the third floor of a steel framed structure was analytically determined. The objective of the investigation was to generate a structural design criterion for the electronic components. Computer storage capability was the controlling consideration in generating the mathematical models. The analysis had to be done in steps: (1) going from the ground for ground shock, and the roof for air blast, to the third floor column lines; (2) going from the column lines to the "black boxes" considered as rigid bodies; and (3) going from the response of the black boxes to the components. It is shown that this approximate analysis using the modal superposition method gives satisfactory results. Parametric considerations affecting this analysis are discussed. Author

N68-25541# Massachusetts Univ., Amherst. Dept. of Civil Engineering.
INFLUENCE OF SHIP MOBILITY ON INTERNAL FORCES PRODUCED BY BLAST
Alexander Chajes, Frederick J. Dzialo, and Merit P. White *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 143–150 refs (See N68-25525 14-32)
(Contract N600(167)65486X(FBM))

A study of the effect of hull mobility on the dynamic behavior of an aircraft carrier subjected to blast loads is presented. Using a simplified model of the carrier, equations of motion and their solutions are derived. From these equations, natural modes, frequencies, and dynamic displacements resulting from a triangular load pulse are obtained for a numerical example. Two cases are studied: one assumes the hull to remain fixed in the water and one allows the hull to move. Comparison of the results for these two conditions indicates that inclusion of hull mobility in the analysis results in a sizable reduction of the design shears for the vertical bulkheads. Hull mobility is also shown to have a significant effect on the natural modes and frequencies. Author

N68-25542# Mechanics Research, Inc., El Segundo, Calif.
DYNAMIC BEHAVIOR OF SHIPBOARD ANTENNA MASTS SUBJECTED TO BLAST-GENERATED OVERPRESSURES
F. Adrian Britt and Robert H. Anderson *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 151–167 refs (See N68-25525 14-32)

A design analysis of a model shipboard antenna and support mast is presented. An overall program directed toward the derivation of a design technique for such structures subject to nuclear blast is discussed in light of the analytic results. A test program, to be performed for the experimental verification of the analytic study is also described. Author

N68-25543# IIT Research Inst., Chicago, Ill.
ABSOLUTE UPPER AND LOWER BOUNDS FOR THE CRITICAL BLAST LOADING ENVIRONMENT OF TARGET ELEMENTS AND SYSTEMS
Eugene Sevin and Walter Pilkey *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 169–176 refs (See N68-25525 14-32)

Mathematical programming formulations are considered for the problem of determining upper and lower bounds on the loading environment capable of causing a prescribed critical response in structures and systems. The formulations will accept as constraints whatever time varying or gross characteristics are known concerning the loading environment. Bounds on properties of loadings within this class are then ascertained so as to establish that a loading environment exhibiting certain characteristics either will always or can never generate a critical response. Specific results are prescribed for the upper and lower bounds of impulses that cause (1) a prescribed displacement in a simple viscous linear elastic system; and (2) the rigid body overturning of a block. The loadings considered are characteristic of blast wave loads. Author

N68-25544# Sandia Corp., Albuquerque, N. Mex.
ELASTIC-PLASTIC COLLAPSE OF STRUCTURES SUBJECTED TO A BLAST PULSE
Walter B. Murfin *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 177–184 refs Sponsored by AEC (See N68-25525 14-32)

A finite difference method is used to analyze the elastic-plastic, large deflection response of shell structures under blast loading. It is shown that, although the usual design methods are adequate for some conditions, they may be over-conservative under other conditions. When the shell structure is surrounded by an elastic medium, elementary design methods are grossly conservative. Author

N68-25545# Ballistic Research Labs., Aberdeen Proving Ground, Md.

INTERNAL LOADING OF STRUCTURES BY BLAST WAVES

Joseph F. Melichar *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 185–191 refs Sponsored by the Office of Civil Defense (See N68-25545 14-32)

The internal loading of a structure, created by the impingement of a blast wave on its exterior, is discussed. The expansion of the shock wave into any chamber of the structure and the subsequent inflow of energy and mass that raise the pressure in the interior are described. A sample structure shows how these aerodynamic processes are related to the loads on internal structural components. The following physical processes are stressed: (1) internal pressure as a pulsating phenomenon whose frequency is a function of the interior's geometry; (2) timing of the pressure pulses as a major factor in determining the loading of the interior; and (3) uneven loading of the internal components because of out of phase pressure pulses as a major cause of damage. Author

N68-25546# IIT Research Inst., Chicago, Ill.

EFFECTS OF SLIDING ON BLAST LOADS REQUIRED TO OVERTURN STRUCTURES

Carlton E. Gebhart *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 193–197 refs (See N68-25525 14-32)

A computer program capable of simulating the sliding and/or tipping of boxlike structures caused by nuclear blast loads is described. A sample problem demonstrates that sliding motions increase the loads required to overturn a structure. Author

N68-25548# Ammann and Whitney, New York.

INCORPORATION OF SHOCK PROTECTION IN EXISTING ABOVEGROUND CYLINDRICAL STRUCTURES SUBJECTED TO NUCLEAR BLAST

Edward Cohen, Samuel Weissman, and Louis Sanchez *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 213–221 Sponsored by Navy (See N68-25525 14-32)

The contents of existing small diameter, aboveground, multistory cylindrical structures, housing equipment and personnel, will be provided with shock protection consistent with the blast capacity (10 to 50 psi for megaton weapon yields) of the concrete structural shell. Large horizontal and rotational motions, in addition to vertical motions, will occur in the cylinder because of its configuration and flexibility. In the development of appropriate shock mounting schemes, every interior component and system was investigated to determine where shock protection was required to assure the survival and postattack operation of all essential electronic components and key personnel. Many restrictions were imposed by the requirement for incorporating shock isolation within small, confined areas in which the equipment requiring protection is already installed. Vertical, horizontal, and rotational shock response spectra at each floor level were used as input to design various shock protection schemes to meet shock tolerance and fragility criteria. Typical designs are illustrated and discussed. These include: (1) spring suspended group platforms to protect sensitive electronic equipment and personnel operating this equipment; (2) individual spring mounted service equipment such as air conditioners and electric panel boxes; (3) rigid mounted items such as fire extinguishers and tools; (4) ruggedized replacements including stronger partition walls and metal toilet units; (5) additional clamps and supports for piping, and flexible utility and power lines connected to spring mounted equipment; and (6) energy absorbing padding. Author

N68-25561# Naval Research Lab., Washington, D. C. The Shock and Vibration Information Center.

THE SHOCK AND VIBRATION BULLETIN, NO. 37. PART 2: INSTRUMENTATION AND ANALYSIS

Jan. 1968 194 p refs Presented at 37th Symp. on Shock and Vibration, Orlando, Fla., 24–26 Oct. 1967; sponsored by the Navy (AD-667227)

CONTENTS:

1. PORTABLE LASER INSTRUMENT FOR VIBRATION ANALYSIS AND TRANSDUCER CALIBRATION G. A. Massey and R. R. Carter (Sylvania Elec. Products, Inc.) p 1–6 (See N68-25562 14-16)

2. HIGH-FREQUENCY MICROPHONE CALIBRATION USING A SUPERSONIC FREE-FLIGHT RANGE C. D. Hayes (JPL) and R. C. Binder (Univ. of So. Calif.) p 7–12 refs (See N68-25563 14-14)

3. METHOD OF MEASURING VIBRATORY DISPLACEMENTS IN TERMS OF A LIGHT WAVELENGTH J. L. Goldberg (Natl. Standards Lab.) p 13–16 refs (See N68-25564 14-23)

4. CALIBRATION OF ACCELEROMETERS BY IMPULSE EXCITATION AND FOURIER INTEGRAL TRANSFORM TECHNIQUES J. D. Favour (Boeing Co.) p 17–27 refs (See N68-25565 14-14)

5. BIDIRECTIONAL SHOCK AND HIGH-IMPACT EFFECTS ON SHOCK TRANSDUCERS V. F. De Vost and P. S. Hughes (NOL) p 29–42 refs (See N68-25566 14-14)

6. INFLUENCE OF FIXTURE STRESS CONCENTRATIONS ON RING ACCELEROMETERS J.A. Nagy and C. E. Henley, Jr. (NASA. Goddard Space Flight Center) p 43–50 refs (See N68-25567 14-14)

7. SONAR TRANSDUCER VIBRATION REQUIREMENTS AND MEASUREMENT TECHNIQUES G. M. Mayer and E. G. Marsh (Navy Underwater Sound Lab.) p 51–55 (See N68-25568 14-14)

8. AUTOMATED VIBRATION ANALYSIS R. Pabich and W. H. Sellers (Raytheon Co.) p 57–63 refs (See N68-25569 14-32)

9. A COMPACT, LOW-COST SHOCK-SPECTRUM ANALYZER W. W. Mebane (NOL) p 65–76 (See N68-25570 14-14)

10. DYNAMIC PHASE PLOTTING T. E. Smart (Sandia Corp.) p 77–86 (See N68-25571 14-32)

11. RANDOM-VIBRATION-INDUCED ERRORS IN A MISSILE CAUSED BY NONLINEAR INERTIAL ACCELEROMETERS N. A. Leifer (Bell Telephone Labs., Inc.) p 87–97 (See N68-25572 14-32)

12. VIBRATION DISTRIBUTIONS IN MULTIPANEL STRUCTURES: COMPARISON OF MEASUREMENTS WITH STATISTICAL ENERGY PREDICTIONS E. E. Ungar and N. Koronaios (Bolt, Beranek, and Newman, Inc.) p 99–107 refs (See N68-25573 14-32)

13. CONSTANT BANDWIDTH FM DATA SYSTEM DESIGNED FOR SATURN S-IVB/V VIBRATION TESTS D. F. Redford (Thiokol Chemical Corp.) p 109–115 refs (See N68-25574 14-32)

14. DYNAMICS PORTION OF GEMINI AGENA TARGET VEHICLE ENGINE MODIFICATION AND TEST PROGRAM (PROJECT SURE FIRE) N. Angelopulos (Lockheed Missiles and Space Co.) p 117–171 ref (See N68-25575 14-28)

15. DYNAMIC ANALYSIS OF COMPLEX STRUCTURES M. D. Benton, G. K. Hobbs (Hughes Aircraft Co.), and J. R. Dickerson (Univ. of Texas) p 173–192 refs (See N68-25576 14-32)

N68-25569# Raytheon Co., Bedford, Mass.

AUTOMATED VIBRATION ANALYSIS

R. Pabich and W. H. Sellers *In* NRL The Shock and Vibration Bull., No. 37, Pt. 2 Jan. 1968 p 57–63 refs (See N68-25561 14-32)

Automated vibration analysis, which utilizes the well-known principles of dynamic analogies, consists of two essential steps: (a) composition of an analogous electrical circuit for the corresponding mechanical system, and (b) preparation of a routine electronic circuit analysis program (ECAP) input data sheet for the digital

computer (ECAP, from International Business Machines Corp., is an integrated system of programs for the design and analysis of circuits, which an engineer can use without any previous knowledge of computer programming). The essentials for using automated vibration analysis are presented by explaining the coding techniques of ECAP and illustrating the details of the method through three completed examples. The examples include the simple oscillator and conclude with a vibrating beam problem. The examples also illustrate the directness and simplicity of the method in finding transient responses and natural frequencies. The automated vibration analysis method eliminates solving a set of differential equations when a transient solution is required and eliminates establishing and solving the determinantal or frequency polynomial in a frequency analysis. Author

N68-25571# Sandia Corp., Albuquerque, N. Mex.
DYNAMIC PHASE PLOTTING
T. E. Smart *In* NRL The Shock and Vibration Bull., No. 37, Pt. 2 Jan. 1968 p 77–86 Supported in part by AEC (See N68-25561 14-32)

The sine-wave vibration testing, continuous plotting of response amplitude vs frequency is commonly accomplished without the attendant phase information. A system for resolving accelerometer signals from sine-wave vibration tests into coincident and quadrature components for the unambiguous rendition of phase relationships is being developed. With commercially available equipment, phase is a difficult parameter to plot on analog plotting systems. Use of complex vectors (Co and Quad phasors) eliminates many of the difficulties of phase measurement and facilitates analog plotting. Phasor information can be transformed into phase information by computer processing. Typical results for the system at its present stage of development are illustrated and discussed. Author

N68-25572# Bell Telephone Labs., Inc., Whippany, N. J.
RANDOM-VIBRATION-INDUCED ERRORS IN A MISSILE CAUSED BY NONLINEAR INERTIAL ACCELEROMETERS
N. A. Leifer *In* NRL The Shock and Vibration Bull., No. 37, Pt. 2 Jan. 1968 p 87–97 (See N68-25561 14-32)

Inertial accelerometers are often used in the feedback loops of guided missiles, comparing the command signal with the response. For a linear accelerometer the error signal produced by the instrument's response to a random vibration usually has its lowest frequency content high enough to make the missile unable to respond to the instantaneous error signal. It responds instead to the mean value, which is zero error. For the nonlinear instrument the mean error is not zero but the bias mentioned above. For a sample input power spectrum and acceleron ter transfer function, the output signal power spectrum is calculated for each of the two assumed curves by calculating the autocorrelation functions of the output and then taking its Fourier transform. The resulting power spectrum is then filtered through the missile's assumed transfer function, and maximum expected response is calculated. An accelerometer was built with an intentional nonlinearity about its null point. It was then subjected to the random vibration used in the analysis, and output was passed through a filter having the same transfer function as that assumed for the missile. The results, based on a normalized scale with the experimental data set at 1, were 0.61 for the quadratic approximation and 1.16 for the straight-line approximation. The straight-line analysis lends itself to a quick and easy method of checking an instrument for vibration-induced error. By making a template consisting of two straight-edged sections and comparing the actual calibration curve to the template, a prediction can be made whether or not a specified error will be exceeded. Author

N68-25573# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
VIBRATION DISTRIBUTIONS IN MULTIPANEL STRUCTURES: COMPARISON OF MEASUREMENTS WITH STATISTICAL ENERGY PREDICTIONS
Eric E. Ungar and Nicholas Koronaios *In* NRL The Shock and Vibration Bull., No. 37, Pt. 2 Jan. 1968 p 99–107 refs Sponsored by AF (See N68-25561 14-32)

The statistical energy analysis approach, as it applies to multipanel structures, is reviewed. A method is presented for determining the required power flow parameters from measurements on structural samples. Vibration distributions predicted for a point-excited planar array of panels separated by reinforcing beams and for a ring-and-stringer-reinforced cylindrical shell are found to be in generally good agreement with experimental results. Author

N68-25574# Thiokol Chemical Corp., Brigham City, Utah.
CONSTANT BANDWIDTH FM DATA SYSTEM DESIGNED FOR SATURN S-4B/5 VIBRATION TESTS
Dean F. Redford *In* NRL The Shock and Vibration Bull., No. 37, Pt. 2 Jan. 1968 p 109–115 refs (See N68-25561 14-32)

Thiokol's Wasatch Division was awarded a contract in January 1966 to conduct vibration tests for the Douglas Aircraft Company on the forward skirt and boattail sections of the Saturn S-IVB/V launch vehicle. The extreme size of the components tested dictated the use of a large-capacity data acquisition system to insure adequate description of the response to high-force vibration excitation. A constant bandwidth FM data acquisition system capable of recording 144 channels of wideband information was designed. The tradeoff studies conducted to evaluate available techniques are discussed, and a detailed description of the constant bandwidth FM system is presented. Author

N68-25576# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
DYNAMIC ANALYSIS OF COMPLEX STRUCTURES
M. D. Benton, G. K. Hobbs, and J. R. Dickerson (Univ. of Texas, Austin) *In* NRL The Shock and Vibration Bull., No. 37, Pt. 2 Jan. 1968 p 173–192 refs (See N68-25561 14-32)

A general computer program for the analysis of structures subjected to static and/or dynamic loading environments has been completed. The program includes several modeling features which are of general interest to the dynamicist and the stress analyst confronted with the problem of analyzing today's complex structures. The general equations of motion are constructed using distributed mass and distributed stiffness characteristics of finite element models, thus providing both mass and stiffness coupling. The ability to include infinitely stiff elements allows modeling elements such as cylinders (described relative to their geometric center) which have protuberances or other elements attached to their periphery. The ability to include flexible and pinned joints as well as zero-mass coordinates in any combination at any station may be used to enhance further the ease and accuracy in modeling a complex structure. Included in the program are routines which will generate a 12 by 12 matrix for any straight-sided body of revolution with or without longitudinal stringers and for a constant-section, symmetric or nonsymmetric beam. Any element not of those two types may be included by direct placement of externally generated stiffness matrices into system stiffness matrix. Author

N68-25591# Lockheed Missiles and Space Co., Palo Alto, Calif.
EXPERIMENTAL CONFIRMATION OF THE PLASTIC FLOW EQUATIONS FOR AN ANISOTROPIC BODY
L. A. Tolokonnikov, V. V. Shevelev, and S. P. Iakovlev [1967] 4 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 4, no. 2, 1968 p 16–19 CFSTI: HC$3.00/MF$0.65

Fundamental plastic flow equations for an anisotropic body were subjected to experimental confirmation, and it was assumed that the fluidity function coincided with the plastic potential. Flat samples that were cut out of sheets were stretched of aluminum alloy, brass, and steel. Graphs showing results of testing indicate that there was not more than a 4% deviation between yield points calculated using Hill equations and those obtained experimentally. Transl. by M.W.R.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N68-24359# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
AN APPARATUS TO MEASURE THE THERMAL CONDUCTIVITY OF GRAPHITE NEAR ROOM TEMPERATURE
J. Van de Velde, H. Ockfen, and T. Noels Brussels EURATOM Apr. 1968 24 p refs
(Contract EURATOM-006-60-6 BRAB)
(EUR-3909.e) CFSTI: HC $3.00/MF $0.65

An apparatus for measuring the coefficient of thermal conductivity for irradiated or nonirradiated graphite specimens has been set up in the LMA's graphite laboratory. The heat transfer principle is used for measuring the coefficient K near room temperature. The graphite specimen placed in a vacuum is held coaxially between the end faces of the two electrolytically pure copper probes which have the same cross-section as the sample, and of which, one is heated and the other is cooled. Author

N68-24411# Oklahoma Univ. Research Inst., Norman.
WIND AND INTERACTION EFFECTS ON FREE-BURNING FIRES
K. G. Huffman, J. R. Welker, C. M. Sliepcevich Dec. 1967 69 p refs
(Contracts CST-1142; OCD-OS-62-89)
(TR-1441-3; AD-664724)

A systematic investigation of the effect of merging on buoyant diffusion flames from burning pools of liquids was made. It was found that the burning rate, and consequently the flame volume and radiation flux to the surroundings, was greatly increased when the burner spacing was such that the flames began to merge into one fire column. When the burner spacing was decreased so that the flames were fully merged, the burning rate tended to drop again. A correlation was developed which would allow the burning rate of interacting or merging, multiple, liquid-fueled fires to be predicted. As the sizes of the multiple fire sources were increased, the increase in burning rate per unit area for merging fires became less as shown by the burning rate per unit area data for hexane and cyclohexane. As the sizes of the individual fires of the multiple array were increased the fires became more opaque to their own radiation; therefore, the radiation from adjacent fires to the fuel surface had less influence. TAB

N68-24413# Brown Univ., Providence, R. I. Engineering Div.
NATURAL CONVECTION FROM A HORIZONTAL CYLINDER IN THE PRESENCE OF A SOUND FIELD GIVING LARGE STREAMING REYNOLDS NUMBERS
G. de Vahl Davis and P. D. Richardson Oct. 1967 74 p refs
(Contract F33615-67-C-1754)
(AF-1754/3; ARL-68-0048; AD-667197)

In a previous paper by Richardson an analysis was made of the extension measurements available in heat transfer from a horizontal heated cylinder in a transverse sound field or in mechanical vibration transverse to its axis. The results were particularly good when the influence of buoyancy was small. This paper extends the analysis to include the buoyancy effect and gives some illustrated solutions. Author (TAB)

N68-24465*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
IRRADIATION OF THERMAL CONTROL COATINGS Final Report, Feb. 1967–Feb. 1968
John F. Scannapieco Feb. 1968 220 p refs
(Contract NAS5-11001)
(NASA-CR-94684; Doc.-68SD4224) CFSTI: HC $3.00/MF $0.65
CSCL 20M

This study investigated the effects of those constituents of the space environment which are most damaging to thermal control coatings and which would be experienced by OAO in about one-half year in space. The coatings investigated were primarily Alzak and white paint. Other surfaces studied were Lexan, Mylar, solar cells, and microsheet. The spectral reflectance of these materials was measured while in the vacuum system after exposure to various combinations of ultraviolet radiation, 2.5 keV protons and 3 keV electrons. Measurements were also performed before and after irradiation in air. Most measurements and irradiations were performed at $-55°C$ and $2 \cdot 10^{-7}$ torr. The ultimate radiation exposure of any sample was 945-equivalent ultraviolet sun hours, $5.6 \cdot 10^{14}$ protons cm^{-2} and $5.8 \cdot 10^{13}$ electrons cm^{-2}. The ultraviolet irradiation was performed at an intensity of nominally 1-equivalent ultraviolet sun hour while the nominal corpuscular fluencies were $8 \cdot 10^{12}$ protons cm^{-2} sec^{-1} and $6 \cdot 10^{12}$ electrons cm^{-2} sec^{-1}. Author

N68-24480# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
THEORY OF LIQUID-GAS TWO-PHASE FLOW, PART 1 [TEORIA DEI MOTI BIFASI LIQUIDO-VAPORE, PART 1]
G. Basso 1968 35 p refs In ITALIAN; ENGLISH summary
(RT/ING(68)1, Pt. 1) CFSTI: HC $3.00/MF $0.65

It is shown that thermohydrodynamic instabilities, such as burn-out, and the various two-phase flow patterns can be physically interpreted and analytically described on a thermodynamic basis, if the compressibility and the thermal expansion of the fluid are taken in due account. The exact theoretical equations which make it possible to determine the critical flow conditions are derived and compared with the experimental results. The status of fluid mechanics and vibration theory are examined with the aim of evaluating the limits of their validity, in the case of diabatic and two phase flows, and with the view to link the theoretic developments to a more general context. Author

N68-24545 Ohio State Univ., Columbus.
THE EFFECT OF RADIATIVE EMISSION AND SELF-ABSORPTION OF THE FLOW FIELD AND HEAT TRANSFER BEHIND A REFLECTED SHOCK WAVE IN AIR
John David Anderson (Ph.D. Thesis) 1966 134 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-2403

The coupling of radiative energy transfer with the high temperature flow field behind a strong reflected shock wave in air was investigated in order to delineate the influence of radiative cooling and self-absorption on high temperature flow fields, in general, and also to compare the relative effects of non-gray, gray, and transparent gases. In all of the above cases, results were obtained for the effects of the radiation–gas dynamic coupling on detailed flow field structure and end wall heat transfer due to both radiation and conduction. In addition, a limited analogy was demonstrated between the above results for the reflected shock problem and the corresponding phenomena for the radiating shock layer near the stagnation point of a blunt reentry vehicle. On a qualitative basis, the inclusion of the radiation–gas dynamic coupling and thermal conduction in the reflected shock region destroys all the simple aspects of ideal shock theory. Flow field properties are no longer constant, but vary both with time and location. Dissert. Abstr.

N68-24574# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
HOTANK: A STEADY-STATE HEAT TRANSFER PROGRAM FOR USE ON THE UNIVAC 1107/1108
W. E. Willingham Feb. 1968 38 p refs
(Contract AT(45-1)-1830)
(BNWL-618) CFSTI: HC $3.00/MF $0.65

A computer program is presented for the calculation of steady-state temperatures in heat and nonheat-generating systems suitable for a two-dimensional system of cylindrical geometry. The program is capable of handling problems with constant or temperature dependent thermal conductivities, internal heat generation, and constant film or contact coefficients. No attempt has been made to include radiation effects within the program. The results are calculated by an iterative process using the nodal or lumped parameter method of analysis. Author (NSA)

N68-24618*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DETERMINATION OF CONVECTIVE HEAT-TRANSFER COEFFICIENTS ON ADIABATIC WALLS USING A SINUSOIDALLY FORCED FLUID TEMPERATURE
Ronald G. Huff Washington Jun. 1968 34 p refs
(NASA-TM-X-1594) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The response of an insulated wall, over which a heated fluid flows, to a sinusoidally forced fluid temperature was used to calculate the convective heat-transfer coefficients. An exact solution is given which accounts for thermal conductivity and the location of the sensed wall temperature in one-dimensional heat-transfer problems. Charts are included to aid in the calculation. A comparative analysis was made of solutions that do not account for thermal conductivity and the location of the sensed wall temperature and those that do. If the exact solution is not used, errors greater than 23 percent are possible. Author

N68-24658# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
SUPERHEATING AND SINGLE BUBBLE EJECTION IN THE VAPORIZATION OF STAGNATING LIQUID METALS
K. H. Spiller, G. Grass, and D. Perschke Jun. 1967 12 p refs
Transl. into ENGLISH from Atomkernenergie (Munich), v. 12, no. 3/4, 1967 p 111–114
(AERE-TRANS-1078) HMSO: 1s 9d

Potassium was heated by direct current above the boiling point and the boiling superheat was measured. Due to the heating technique employed surface roughness elements normally acting as nucleation centers could be made largely inactive. Chemico-physical impurities likely to promote nucleation were removed employing special purification procedures. Under these extreme conditions boiling superheats in the range 70–820°C were measured. It was shown that during the bubble expansion a superheated layer of potassium having a thickness of 0.07–0.23 mm adheres to the wall. The evaporation of this layer may be responsible for the continuing expansion of the vapor space. Author

N68-24659*# Brown Univ., Providence, R. I. Div. of Engineering
ON RADIATIVE TRANSFER IN THE LOW REYNOLDS NUMBER BLUNT BODY STAGNATION REGION AT HYPERSONIC SPEEDS. PART 1: EMISSION DOMINATED CASE
Joseph T.C. Liu Mar. 1968 35 p refs
(Grant NGR-40-002-009; Contract Nonr-562(35))
(NASA-CR-94699; Nonr-562(35)/21) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Objectives of this paper are: (1) to contribute to an understanding of radiative transfer effects in the low Reynolds number or merged layer regime of hypersonic flow about axisymmetric blunt bodies; and (2) to illustrate how the concept of thin shock layer theory can be extended to the radiative case through the introduction of a pseudo-jump condition across the shock structure, accompanied by an iteration technique. The radiative transfer is simplified to the emission dominated case. The gas is taken as calorically and thermally perfect, the viscosity taken as a linear function of the temperature, and the absorption coefficient of the gas is assumed to be gray. The problem is formulated for the flow about a blunt body but the detailed calculations are carried out for the stagnation region in order to illustrate the techniques used. Radiative cooling decreases the convective heat transfer from the corresponding radiationless case. Radiative contributions become less important toward the free-molecular range. Radiative cooling decreases the overall shock structure and shock layer thicknesses. Author

N68-24692 Ohio State Univ., Columbus.
INVESTIGATION OF THE DETONATION OF ALUMINUM POWDER-OXYGEN MIXTURES
William Anthony Strauss (Ph.D. Thesis) 1966 124 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-2546

It has been shown that fine aluminum powder–oxygen mixtures are detonable over the mixture ratio range of 48 to 64 percent fuel (by mass). The detonation induction distances of these mixtures are less than 1.6 meters in length (for 26.4 mm diameter tubes) and decrease with increasing mixture ratio. The detonation wave velocities for the lean mixtures are approximately 1550 m/sec and decrease slowly with increasing mixture ratio. The detonation pressures were found to be approximately 31 atm over the entire mixture ratio range. The measured detonation velocity and detonation pressure values are approximately 9 and 14 percent, respectively, below the Chapman–Jouguet theoretical values. The flame fronts of the detonating mixtures spin in a manner similar to the spin observed in detonating carbon monoxide–oxygen mixtures. The frequencies and wavelengths of the spinning flames have been related to transverse pressure waves in the reaction zone. Dissert. Abstr.

N68-24696*# Bendix Corp., Davenport, Iowa. Instruments and Life Support Div.
DEVELOPMENT OF SUPERCRITICAL PRESSURE CRYOGENIC STORAGE AND SUPPLY SYSTEMS INCORPORATING THE RADIAL BUMPER-DISCRETE SHIELD DESIGN Final Report
Bruce Gerth and Robert Lundeen 11 Apr. 1968 203 p refs
(Contract NAS9-2978)
(NASA-CR-92137; Publ.-3873-67) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The Phase A portion of the program resulted in the fabrication of a 2.5 ft^3 supercritical oxygen storage system. This early effort demonstrated the physical integrity and low thermal transfer properties associated with the Bendix-developed radial bumper inner support concept, and also revealed greater thermal barrier efficiency for a storage vessel through the use of discrete radiation shields suspended in the vacuum annulus between the pressure vessel and the outer shell. The Phase B program, an extension of the Phase A program, was hardware oriented to produce two flight-sized self contained supercritical systems, one 4.8 ft^3 oxygen system and one 6.7 ft^3 hydrogen system. The system embodied advanced thermal and structural concepts with emphasis on design, weight optimization, processing, fabrication, and assembly. The Phase B program successfully demonstrated that large flight-type cryogenic storage systems utilizing the radial bumper support and discrete radiation shielding can be built to meet extremely low heat leak requirements necessary for future long duration space missions. Author

N68-24750# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
ENTHALPY MEASUREMENTS OF UO_2 AND TUNGSTEN TO 3260°K

R. A. Hein and P. N. Flagella 16 Feb. 1968 21 p refs Presented at the 70th Ann. Meeting of the Am. Ceram. Soc., Chicago, 20–25 Apr. 1968
(Contract AT(40-1)-2847)
(GEMP-578; CONF-680480-1) CFSTI: HC $3.00/MF $0.65

Enthalpy data are reported for UO_2 at 1200 to 3260°K. In these measurements, stoichiometric ($O/U = 2.003 \pm 0.003$) UO_2 was sealed in evacuated tungsten capsules and heated in a hydrogen atmosphere furnace. A drop technique was employed in conjunction wtih an adiabatic water calorimeter to measure the heat releases which were then converted to enthalpies. A discontinuity in the enthalpy-temperature curve at 3115°K was used to calculate the heat of fusion as 18.2 ±0.5 kcal/mole. Prior to these tests similar measurements were made of the enthalpy of tungsten to 3250°K. These results were found to be in excellent agreement with existing high-temperature data for this material and hence the accuracy of the technique used seems to be well established. A comparison is made between the current data and previously reported values for both the enthalpy and heat of fusion of UO_2. Author (NSA)

N68-24767# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE ANALYSIS OF A POROUS BODY MODEL AT HIGH TEMPERATURES
S. P. Detkov 1968 13 p refs Transl. into ENGLISH from Prikl. Mekh. i Tekhn. Fiz., no. 1, 1968 p 105–112

In the model considered, a one-dimensional body is represented by a system of identical axisymmetric channels in a continuum. The temperature gradient coincides with the channel axis, and a gas or liquid is passed through the channel to increase the thermal resistivity. The heat flux is determined, by calculating the temperature field, which is needed for determining the material behavior. Stationary heat transfer is considered. The general assumptions are local thermodynamic equilibrium, gray and diffuse radiation, opaque walls, and isotropic scattering. Author

N68-24795# California Univ., Livermore. Lawrence Radiation Lab.
THERMODYNAMIC PROPERTIES OF SODIUM AND POTASSIUM
J. L. Oldham 2 Feb. 1967 53 p refs
(Contract W-7405-ENG-48)
(UCID-15271) CFSTI: HC $3.00/MF $0.65

Mollier diagrams were developed for K and Na at 0.1 to 100 atm and temperatures to 2500°K. Four techniques were used to determine the thermodynamic properties: virial, equation of state, corresponding states, and quasichemical analysis. A computer code was developed to calculate enthalpy, entropy, specific heat, and PVT values of Ce, K, and Na. Input constants for the properties code are given which compute enthalpy, entropy, specific volume, molecular weight, specific heat, and molecular composition. NSA

N68-24796# California Univ., Livermore. Lawrence Radiation Lab.
LIQUID AND VAPOR DENSITIES AND CRITICAL TEMPERATURES FOR THE ALKALI METALS
O. H. Krikorian 4 Oct. 1966 16 p refs
(Contract W-7405-ENG-48)
(UCID-15269) CFSTI: HC $3.00/MF $0.65

Literature pertaining to the liquid and vapor densities and critical temperatures of alkali metals for space power systems is reviewed and discussed. Subjects considered include density relationships at the critical point, principle of corresponding states, Kordes relationship, and treatment of data. Data on liquid and vapor densities of Cs, K, Na, and Rb are summarized in diagrams as is the Kordes function plot for Cs, Hg, K, Li, Na, and Rb. Critical temperatures, densities, and a comparison of calculated versus observed liquid and vapor densities of these metals are shown in tables. NSA

N68-24810*# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
AN EXPERIMENTAL INVESTIGATION OF NEAR CRITICAL AND SUPERCRITICAL BURNING OF BIPROPELLANT DROPLETS
D. P. Dominicis 10 Apr. 1968 86 p refs
(Grant NGR-39-009-077)
(NASA-CR-72399) CFSTI: HC $3.00/MF $0.65 CSCL 21B

This report presents the results of an investigation of droplet combustion in air at pressures sufficiently high for the droplet to exceed its critical temperature during combustion. For the tests, the droplet was supported from a quartz fiber or a thermocouple, contained within a small pressurized chamber. To prevent the droplet from falling from its support due to reduced surface tension, the experiment was carried out under zero-gravity conditions. Combustion lifetimes and droplet temperature measurements are reported over a pressure range from 100 to 2000 psia for n-decane and n-hexadecane. Experimental supercritical burning times were found to agree reasonably well with available theoretical predictions. Author

N68-24821# International Atomic Energy Agency, Vienna (Austria).
THE PLUTONIUM–OXYGEN AND URANIUM–PLUTONIUM–OXYGEN SYSTEMS: A THERMOCHEMICAL ASSESSMENT
1967 86 p refs Presented at a Panel on Thermodyn. of Plutonium Oxides, Vienna, 24–28 Oct. 1966 *Its* Tech. Rept. Ser. No. 79
(STI/DOC-10/79) Available from Intern. Atomic Energy Agency: $2.00

Structural and thermodynamic data for the Pu–O and U–Pu–O systems are reviewed. Plutonium oxides, the uranium–plutonium–oxygen system, and other PuO_2–MeO_x oxide systems are discussed. Author (NSA)

N68-24852 Houston Univ., Tex.
FORCED CONVECTION IN CONCENTRIC SPHERE HEAT EXCHANGERS
Herbert Alton Rundell (Ph.D. Thesis) 1966 85 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-2037

An experimental investigation of the spherical heat exchanger has been conducted. The geometry consists of two concentric spheres with fluid flowing through the annulus between the spheres. For the case of forced convection, the fluid enters and exits the annulus through diametrically opposed openings in the outer sphere. The sphere is unique since it provides a maximum volume per unit surface area and is an ideal system when a condition of maximum capacity with minimum exposed surface is required. Four different sphere-size combinations are studied experimentally to determine the characteristics of the concentric-sphere heat exchanger; the inner sphere is a constant-temperature heat source; water flows through the annulus as a coolant. Flow visualization techniques are employed to study the flow patterns in the annulus. Photographic results are presented; the flow exhibits toroidal mixing; a separation point occurred at an angular location $\theta = 50°$ downstream of the entrance region. Dissert. Abstr.

N68-24913# Electrotechnical Lab., Tokyo (Japan).
ABSOLUTE MEASUREMENT OF RADIANT FLUX
Nobuhide Ooba Dec. 1967 72 p refs In JAPANESE; ENGLISH summary *Its* Res. of the Electrotech. Lab. No. 675
CFSTI: HC $3.00/MF $0.65

Initial research is reported on the first step of activities aimed at the establishment of radiometric standards in the spectral region of near UV, visible, and near IR, and as the result, the irradiance (radiant flux per unit area) which is given by an incandescent standard lamp has been determined by a group of absolute radiometers, so that the calibration of radiometers for general use has been made possible in absolute scale. In the present

absolute radiometer, the receiver plate is a thin silver disk, and a fine plutinum wire which is wound spirally and bifilarwise is attached to the disk in good thermal contact and electrical insulation. The temperature rise of the plate is detected by the change in electric resistance of the Pt-wire. The incident radiant flux is absorbed by a layer of gold black which is made by evaporation on the surface of the receiver, on the other hand, the electric power is introduced into the Pt wire and dissipated to heat. Author

N68-24950# Royal Aircraft Establishment, Farnborough (England).
THE EQUILIBRIUM COMPOSITION OF HIGH TEMPERATURE AIR CONTAINING WATER VAPOUR
A. S. Palmer and Diana O'Mahony Nov. 1966 80 p refs
(RAE-TR-66354) CFSTI: HC $3.00/MF $0.65

Results are presented on a theoretical investigation of the high temperature equilibrium composition of air containing water vapour. A digital computer program is used to solve the simultaneous non-linear equations which describe the chemical equilibrium between the compounds and their constituent elements. The temperature range considered is 1500°K to 6000°K and the pressure range is 0.001 to 10 times that of the normal atmosphere. The water vapor content is varied between 0.001 and 1 per cent and the calculated equilibrium composition involves 43 chemical species. Author

N68-24985*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MIXING AND REACTION STUDIES OF HYDRAZINE AND NITROGEN TETROXIDE USING PHOTOGRAPHIC AND SPECTRAL TECHNIQUES
Marshall C. Burrows Washington, D. C. Jun. 1968 26 p refs Film Supplement Number C-258 to this Report is Available on Loan from Lewis Research Center, Cleveland
(NASA-TN-D-4467) CFSTI: HC $3.00/MF $0.65 CSCL 21B

Distances required to atomize, mix, and react N_2H_4 and N_2O_4 were experimentally determined for a quadlet injector element. Atomization occurred in less than 1 inch (2.5 cm), and vaporizing NO_2 extended downstream for 4 inches (10.2 cm) or less. Hottest gases were in the oxidant-rich zones; fuel-rich gases appeared to be influenced by the decomposition reaction of hydrazine. Concentration profiles of H_2O determined from total radiation and gas temperature compared favorably with H_2O concentrations calculated for combustion profiles limited by either fuel or oxidant vaporization. Author

N68-24989* Lockheed Missiles and Space Co., Sunnyvale, Calif.
A STUDY OF THE EFFECTS OF ENVIRONMENTAL AND ABLATOR PERFORMANCE UNCERTAINTIES ON HEAT SHIELDING REQUIREMENTS FOR HYPERBOLIC ENTRY VEHICLES. VOLUME 2: SUMMARY OF CALCULATIONS
L. F. Hearne, W. D. Coleman, J. M. Lefferdo, L. W. Gallagher, and J. H. Chin [1968] 556 p refs
(Contract NAS2-4219)
(NASA-CR-73225) CFSTI: $3.00 CSCL 20M

This output from an automatic plotting sub-routine attached to the ablator material response prediction code shows the various quantities for the nylon-phenolic heat shielding material as a function of flight time from 400,000 feet altitude. Some of the curves do not extend completely to the end of the heating curve period due to computer storage limitations. Data for two locations on an Apollo and on a biconic geometry cover radiative and convective heating rates; surface temperature histories; material degradation through surface recession and char layer thickness; and energy accommodation histories. G.G.

N68-25088 Iowa State Univ. of Science and Technology, Ames.
MODELS OF THERMAL BEHAVIOR OF RADIATIVE SURFACES
Paul Walden Barcus (Ph.D. Thesis) 1966 64 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-2041

A method of predicting prototype temperatures is developed based on distorted model theory. This procedure retains the best features of material preservation, while keeping model and prototype temperatures near the same value. Many of the restrictions which make a true model impractical to construct are removed. Heat transfer in an enclosure irradiated by solar radiation and emitting to the 140°R walls of a vacuum chamber is analyzed according to the principles of engineering similitude, and five dimensionless ratios, or Pi terms are developed which completely describe the phenomenon. Using an IBM 360 digital computer, steady state temperatures at various zones in the enclosure are solved for, and used to determine total radiation interchange factors within the enclosure. These factors were inserted into the prototype heat balance equations to determine prediction factors used to translate model temperatures into homologous prototype temperatures. It is shown that the accuracy of the method is high, and that complex shapes, large length scales, and severe environments can be handled by the method. Dissert. Abstr.

N68-25102*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL VERIFICATION OF A DOUBLE DEAD TIME MODEL DESCRIBING CHUGGING IN LIQUID BIPROPELLANT ROCKET ENGINES
John R. Szuch and Leon M. Wenzel Washington May 1968 38 p refs
(NASA-TN-D-4564) CFSTI: HC $3.00/MF $0.65 CSCL 21B

Stability limits were determined, experimentally, for a 2-inch (5.08 cm) diameter rocket engine. Liquid oxygen and gaseous hydrogen were the propellants. Chamber pressures of 650 and 300 psia (4.48×10^6 and 2.07×10^6 N/m^2) were run with an oxidant-fuel ratio of 5.0 and a characteristic length of 95 inches (2.41). For comparison with experimental data, boundaries were generated on the analog computer using the chugging model proposed by the authors and calculated values of delay. Results agreed with regard to observed frequencies and boundary shape. Discrepancies in boundary location (required pressure drops) were attributed to a high combustion noise level. Author

N68-25122*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VAPOR PRESSURE OF POTASSIUM TO 2170°K
Kenneth J. Bowles Washington May 1968 12 p refs
(NASA-TN-D-4535) CFSTI: HC $3.00/MF $0.65 CSCL 20M

A static capsule method was used to measure the vapor pressure of potassium from 945° to 2170°K. The resulting Kirchhoff-type vapor-pressure equation is given. The standard deviation in pressure is ±1.23 percent. Data calculated from this equation were pooled with data calculated from potassium-vapor-pressure equations determined previously in four independent studies. The pooled equation is used as a standard curve against which all data are compared. Author

N68-25126 Catholic University of America, Washington, D. C.
ANALYSIS OF EFFECTS OF WALL TEMPERATURE AND PRANDTL NUMBER ON SUBSONIC BOUNDARY LAYER THICKNESSES FOR ROTATIONALLY SYMMETRIC FLOW AND APPLICATION TO TURBULENT FLOW SEPARATION
William J. Kelnhofer (Ph.D. Thesis) 1966 147 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-1489

The effects of wall temperature and Prandtl number on subsonic boundary layer thicknesses are theoretically determined. N-power profiles of velocity and temperature distributions in the boundary layer are assumed. The ratio of the velocity to thermal boundary layer thicknesses is assumed to be a function of Prandtl

number only. The results show that all boundary layer thicknesses are significantly effected by wall temperature variations. The effects are greater for laminar flow than for turbulent flow. As the Prandtl number increases, the wall temperature effects decrease. The results as presented are useful to quickly determine the effects on both laminar and turbulent boundary layer thicknesses relative to adiabatic flow. Also, the results are used to formulate the streamwise variation of the momentum loss thickness and shape factor as effected by wall temperature. An approximate method of computation is developed using the integral mechanical energy equation, and indicates that the streamwise accumulation of the momentum loss thickness decreases as the temperature of the wall increases, and vice versa. Dissert. Abstr.

N68-25144# Lockheed Missiles and Space Co., Palo Alto, Calif.
COMPUTATION OF ENERGY TRANSFER BY RADIATION IN A CONTINUOUS SPECTRUM TAKING ACCOUNT OF THE FREQUENCY ABSORPTION COEFFICIENT IN THE PRESENCE OF REABSORPTION
I. S. Voronina, V. P. Zamuraev, and V. G. Sevast'ianenko [1967] 7 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 1, 1968 p 98–102

The energy transfer by radiation, the energy flux, and its divergence were calculated for a plane argon layer 2 cm thick with a given symmetric temperature profile. The computations were made for pressures of 1 and 100 atm. At 1 atm the radiation connected with the free–free transitions and recombination at the excited levels is primarily transparent and its contribution to the heat exchange can be taken into account directly. Radiation in photorecombination is reabsorbed in the ground state. Computations were made for this process. At 100 atm the radiation for the argon layer is reabsorbed in decelerating processes and photo-recombination at excited levels. The absorption coefficient for photoionization from the ground state and due to photoionization from excited levels and free–free transitions were calculated. The computations were carried out using exact expressions for the energy flux and its divergence as well as in a diffusion approximation. R.N.A.

N68-25236 Pennsylvania State Univ., University Park.
TRANSIENT DROPLET GROWTH DURING DROPWISE CONDENSATION
Charles Joslin Hurst (Ph.D. Thesis) 1968 157 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-1933

An investigation was undertaken to see if the basis for the high heat transfer rates observed during dropwise condensation could be determined from an analysis of a single condensate droplet growing on a convectively cooled surface. A mathematical model of a single droplet was considered which included not only the droplet itself, but a portion of the condensing surface on which it was resting as well. The temperatures obtained in this analysis were then verified experimentally for condensate droplets growing on a very thin horizontal copper surface. The basic assumptions on which the mathematical analysis was based included transient conduction as the mechanism of heat transfer through both the droplet and the condensing surface and on condensation between droplets. The coupled heat and mass transfer from the vapor to the droplet was calculated from equations based on the kinetic theory of gases, and the heat rejection from the rear of the condensing surface was assumed to occur by convection. Thus, the only boundary temperatures which were specified were those of the saturated steam and of the cooling fluid. Finally, the droplet diameter was not considered to be fixed, but was considered to change in accordance with the rate of condensate accumulation which must occur within the droplet. Dissert. Abstr.

N68-25244*# Itek Corp., Palo Alto, Calif. Vidya Div.
AN ANALYSIS OF THE COUPLED CHEMICALLY REACTING BOUNDARY LAYER AND CHARRING ABLATOR, PART 1 Summary Report
Robert M. Kendall, Eugene P. Bartlett, Roald A. Rindal, and Carl B. Moyer Washington, D. C. NASA Jun. 1968 111 p refs (Contract NAS9-4599)
(NASA-CR-1060; Rept.-68-7, Pt. 1) CFSTI: HC $3.00/MF $0.65 CSCL 20M

This report summarizes analyses and computational procedures for predicting the transient in-depth response of charring ablation materials, either coupled to a nonsimilar, laminar, multicomponent, chemically-reacting boundary-layer computational procedure or partially decoupled through the use of convective transfer coefficients. The computational procedure for charring ablators is an implicit finite difference procedure for an ablating surface material with several nonablating backup materials. It considers one-dimensional heat and mass transfer along thermal streamtubes of arbitrary cross-sectional area and permits a multiple-reaction model for gas decomposition and a general thermochemical surface boundary condition. The boundary-layer procedure utilizes a newly developed integral matrix solution procedure. It applies for general chemical systems, allowing rate-controlled surface reactions, and incorporates approximate formulations for mixture transport properties, including unequal diffusion and thermal diffusion coefficients for all species. Analyses are also presented for extending the boundary-layer computational procedure to include mixed equilibrium–nonequilibrium, homogeneous or heterogeneous general chemical systems and to include radiation absorption and emission, and for extending the charring ablation procedure to include char-density buildup due to coking reactions in depth. Author

N68-25248 Kansas State Univ., Manhattan.
SUPERSONIC BASE DRAG IN THE PRESENCE OF BASE BURNING
Bong Lung Koh (Ph.D. Thesis) 1968 100 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-695

An equilibrium combustion model is assumed for the purpose of investigating the effects of hydrogen bleed into the separated base region behind a rearward facing step and the resulting combustion which occurs in the free boundary layer separating this recirculating region from the free stream. A system of equations describing the conservation of mass, concentration, momentum and energy is utilized. Solutions including recompression coefficient, temperature and concentration profiles are obtained by iterated numerical integration. Mager's compressibility transformation and Eckert's reference enthalpy method were applied to the equilibrium combustion model in an attempt to account for the effects of compressibility. An improved description of base flow with burning is thus obtained. Dissert. Abstr.

N68-25277*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THERMOANALYSIS OF ABLATION MATERIALS
George F. Sykes and James B. Nelson [1967] 9 p refs Presented at the Am. Inst. of Chem. Engr. Meeting, Houston, Tex., 19–23 Feb. 1967
(NASA-TM-X-59641) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The performance of ablative thermal protection materials is generally evaluated in ground test facilities. Results of these tests are then used in analytical studies to predict the behavior of the materials during atmospheric reentry. The thermochemical properties of the ablation material, which are determined by studies of the decomposition of the material, must be used in these analyses. The results of some recent studies of the pyrolysis of a charring ablator are presented in this paper. By employing thermoanalytical techniques, the thermochemical properties such as heat of pyrolysis, pyrolysis temperatures, and kinetic parameters describing mass loss have been determined. Analysis of the pyrolysis

products have also been made. This information can now be used in analytical studies to predict more accurately the performance of this material on reentry vehicles. Although data will be presented for only one particular material, the methods described are applicable to the analysis of any heat-shield material of interest. Author

N68-25305# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.

EXPERIMENTAL STUDY OF FLUX DEPRESSIONS AND ANTIREACTIVITIES CREATED BY IRRADIATION LOOPS [ETUDE EXPERIMENTALE DES DEPRESSIONS DE FLUX ET ANTIREACTIVITIES CREES PAR LES DISPOSITIFS D'IRRADIATION]

Dominique Roche Nov. 1967 120 p refs In FRENCH
(CEA-R-3173)

Methods for fast computing of thermal flux depressions and reactivities created by irradiation-loops in natural water reactors are studied. The classical methods of approximation which have been used are: diffusion theory or absorption-probability calculations for the flux-depression and perturbation theory for the antireactivities. Pertinent formulas are compiled together with graphs from theoretical calculations. These formulas and graphs have been checked from numerous experiments which show that the approximations used here are quite close to the actual physical situation, even when the theories are based from assumptions which are not verified. Author (NSA)

N68-25312*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ANALYTICAL INVESTIGATION OF ELECTRICALLY HEATED WIRE MESH FOR FLOWING GAS HEATERS

William F. Mattson and William L. Maag Washington June 1968 42 p refs
(NASA-TN-D-4595) CSCL 13A

By specifying the gas, the flow rate, the system pressure, the desired inlet and outlet gas temperatures, and the power supply characteristics, a compatible wire mesh heater element design can be determined. The calculations involve solving simultaneous equations for the heat generation rate, the convective heat transfer from the mesh to the gas, and the change in enthalpy of the gas at every axial position along the heater length. The method also enables the determination of the operating conditions of an existing mesh heater when used at some off design condition or with another gas. Author

N68-25326*# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.

LOW SOLAR ABSORPTANCE AND EMITTANCE SURFACES UTILIZING VACUUM DEPOSITED TECHNIQUES Final Report, 1 Jun. 1967–25 Mar. 1968

S. A. Greenberg and D. A. Vance Mar. 1968 83 p refs
(Contract NAS2-3063)
(NASA-CR-73228; LMSC-4-06-68-1) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The optical properties of vacuum deposited silver and dielectric films are characterized, and the stability of these coating systems under conditions of high temperature, proton radiation, and ultraviolet radiation is determined. Attention was focused on the transmittance versus thickness of vacuum deposited silver films; the preparation, optical characteristics, and stability of the OSR (optical solar reflector), which is a second surface fused silica reflector coating system for attaining low solar absorption and low ratio of solar absorptance to infrared emittance; and the influence of thin (200 Å to 1000 Å) dielectric coatings upon the total hemispherical emittance of a vacuum deposited silver surface. Experimental deposition procedures are detailed, and test results are analyzed. The findings indicate: (1) The stability of the OSR, under conditions of 2 keV proton radiation, was excellent, and no degradation occurred on exposure at substrate temperatures up to 700°K. (2) The transmittance of silver films on silica and sapphire substrates were an exponential function of the film thickness for silver films thicker than approximately 500 Å M.G.J.

N68-25332*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECT OF TWO-DIMENSIONAL MULTIPLE WAVE DISTORTIONS ON THE HEAT TRANSFER TO A WALL AT MACH NUMBERS OF 6 TO 20

M. H. Bertram, L. M. Weinstein, A. M. Cary, Jr., and J. P. Arrington [1968] 48 p refs Presented at 1968 ASME Winter Ann. Meeting, Cooling and Heating Effects on Boundary Layers, New York, 27 Nov.–1 Dec. 1968
(NASA-TM-X-59597) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An extensive series of tests have been made in hypersonic flow of the heating distribution on a surface in which a series of shallow protruding waves were embedded. The evidence indicates the problem at the first wave is in part amenable to analysis by simple laminar separation concepts even when the displacement thickness of the boundary layer is greater than the height of the protruding wave. Succeeding waves in the train of five peaks were found to have little change in peak heating from what one would predict utilizing the first wave results and assuming that the wave being analyzed was independent of any other wave on the plate. When the boundary layer was transitional or turbulent, vortices were indicated in the separated flow areas by surface flow studies. The turbulent peak heating data were found to correlate in much the same manner as the laminar results, but with a different Mach number effect. Tests on single waves in turbulent flow indicated that the peak heating on shallow waves with attached flow could be predicted, but on waves which caused flow separation the peak heating was significantly higher than the predictions. Author

N68-25333*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THE EFFECT OF A VERTICAL MAGNETIC INDUCTION ON THE NUCLEATE BOILING OF MERCURY OVER A HORIZONTAL SURFACE

O. C. Faber, Jr. and Y. Y. Hsu Washington 1967 30 p refs Presented at the Natl. Heat Transfer Conf., Seattle, 6–9 Aug. 1967; Sponsored by AICE and ASME
(NASA-TM-X-52295) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Nucleate boiling of mercury was carried out on a horizontal surface in a vertical magnetic induction. When the heat flux was less than 300 KW/m^2, an increasing of magnetic induction up to 4 teslas caused a significant reduction in heat transfer. Beyond 4 teslas, no further reduction of heat transfer was observed. For the heat flux range between 300 to 550 KW/m^2 magnetic effect on boiling was much smaller. The possible effects of magnetic induction on various boiling mechanisms were discussed. Author

N68-25335# Bolkow Entwicklungen K. G., Munich (West Germany).

THERMAL STRATIFICATION IN PRESSURE GAS ADMISSION OF FUEL TANKS [THERMISCHE SCHICHTUNG IN DRUCKGASBEAUFSCHLAGTEN TREIBSTOFFTANKS]

Eric Huber 16 Sep. 1968 44 p refs In GERMAN Presented at the Ann. Meeting of the DGRR/WGLR, Bad Godesberg, West Germany, Oct. 1968
(FM-348-0) CFSTI: HC $3.00/MF $0.65

A model study is performed to determine the heat and mass exchange processes in a rotation-symmetric propellant tank partially filled with cryogenic liquid. The tank is heated from the outside, and acceleration in axial direction occurs. Liquid propellant is drawn from the bottom of the tank while a warm, condensable gas is pressed in at the top. The model is suitable for numerical integration by digital computer and using a FORTRAN program. Transl. by K.W.

N68-25347# General Electric Co., Sunnyvale, Calif. Advanced Products Operation.

THE THERMAL CONDUCTIVITY OF URANIUM AND URANIUM–PLUTONIUM OXIDES

F. J. Hetzler, T. E. Lannin, K. J. Perry, and E. L. Zebroski Aug. 1967 32 p refs

(Contract AT(04-3)-189)

(GEAP-4879) CFSTI: HC $3.00/MF $0.65

The thermal conductivities of $UO_{1.97}$ to $UO_{2.01}$ and (0.2 Pu-0.8 U)$O_{1.98}$ to (0.2 Pu–0.8 U)$O_{2.05}$ were studied at 800 to 1900°C. Sintered pellet thermal conductivities were measured with thermal gradients typical of operating reactor fuel. Gradients from 450 to 3000°C cm were typical. The results of these measurements indicate that the thermal conductivity of mixed oxide decreases with increasing temperature from 800 to 1900°C; stoichiometric mixed oxide and UO_2 of 95% theoretical density have similar thermal conductivities at 1000 to 1900°C. Below 1000°C, the thermal conductivity of UO_2 is higher (The values measured for stoichiometric UO_2 in this work are in general agreement with those found in the literature.); and the thermal conductivity of hypostoichiometric UO_2 is higher than that of stoichiometric material at low temperatures but decreases rapidly to coincide with the conductivity of stoichiometric material at a temperature region which corresponds to dissolution of liquid uranium in the urania lattice. Author (NSA)

N68-25372 Michigan State Univ., East Lansing.

A STUDY OF DROPWISE CONDENSATION

Ronald Luther Reisbig (Ph.D. Thesis) 1966 163 p

Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-1675

Dropwise condensation of water vapor was studied on a vertical 1 foot high copper surface having an area of 1 ft^2. Dropwise condensation was promoted by coating the surface with a 0.0017 inch thick film of polytetrafluoroethylene (teflon). Two experiments were performed to study the phenomenon. A heat transfer experiment was made to determine the heat flux and the heat transfer coefficient as a function of condenser surface temperature. The mechanism of dropwise condensation was studied experimentally by taking a series of high speed motion pictures. The heat transfer conditions were determined while the pictures were being taken. Using results of the photographic experiment and theoretical analysis, a mechanism is proposed for dropwise condensation which was used as the basis for the derivation of equations for the heat flux and the heat transfer coefficient. These equations, which were derived using a kinetic theory approach, are shown to correlate very well with the experimental data. Dissert. Abstr.

N68-25426*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ANALYSIS OF ABLATION PRODUCTS AND BOUNDARY LAYER CHEMISTRY OF ABLATING MATERIALS WITH A MASS SPECTROMETER

Ronald B. Pope and John A. Parker 1967 25 p refs Presented at the 3d Intern. High Temp. Technol. Symp., Asilomar, Calif., 17–20 Sep. 1967

(NASA-TM-X-60482) CSCL 20M

As a preliminary step in developing in situ techniques for routine arc jet application, the ablation chemistry of polytetrafluroethylene (Teflon) was studied. In the method used, gaseous species produced by ablation in both inert and chemically active arc jet streams, at high heating rates, are sampled at the ablating surface and collected for subsequent analysis with a mass spectrometer. The sample obtained contains products from reactions both at the surface and in the boundary layer. The spectrometer was also used to evalute the various calibration gases, and the spectra from these gases were then used to analyze and quantitatively identify the species in the sample volume. Data are presented on the behavior of solid Teflon when heated, and the ground state ablation gas–boundary layer sample analyses. An assessment of these data show that the chemical reactions in the high temperature boundary layer around an ablating Teflon surface can be extremely complex. It is concluded, however, that the feasibility of studying the chemistry of the ablation process in simulated entry environments was demonstrated. M.G.J.

N68-25547# General American Transportation Corp., Niles, Ill. Research Div.

USE OF DETONABLE GAS EXPLOSIONS FOR BLAST AND SHOCK STUDIES

Milton R. Johnson and Marion J. Balcerzak *In* NRL The Shock and Vibration Bull., No. 37, Pt. 4 Jan. 1968 p 199–211 refs (See N68-25525 14-32)

Successful spherical detonation experiments have been conducted with gas mixtures in above ground spherical balloons up to 32 ft in diameter and in ground level hemispheres up to 125 ft in diameter. These experiments have shown that the air shock wave phenomena resulting from the gaseous detonation are much clearer and distinct in the high pressure region than those normally observed on detonations of high explosives. This may be explained in terms of a Taylor instability and the fact that the combustion products of a detonable gas explosion are initially less dense than the surrounding air, whereas with a high explosive they are more dense. Author

N68-25588# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.

ON THE INFLUENCE OF NORMAL PROCESSES IN THE THERMAL CONDUCTIVITY OF INSULATORS AND OF FERROMAGNETIC INSULATORS [SOBRE LA INFLUENCIA DE LOS PROCESOS NORMALES EN LA CONDUCTIVIDAD TERMICA DE AISLANTES Y DE AISLANTES FERROMAGNETICOS]

Blas Alascio 1967 17 p refs In SPANISH

(CNEA-201) CFSTI: HC $3.00/MF $0.65

The quantity of heat that passes per second past an infinite plate of insulating material of width 2a is calculated, in which a temperature difference is maintained between its two surfaces for the limited cases in which the inequalities have a value of $2a >> \Lambda$ and $2a << \Lambda$ (Λ being the mean free path of the excitations). The calculation is repeated for a ferromagnetic insulator. In the two cases, it is assumed that only normal processes are of importance in the calculated conditions. It is shown that the flow in the case of $\Lambda << 2a$ is substantially different than the flow in the case of $\Lambda << 2a$, being larger or smaller than this. Transl. by R.N.A.

N68-25609 Iowa State Univ. of Science and Technology, Ames.

THE HEAT CAPACITY OF SOLID He^3

Howard Harshaw Sample (Ph.D. Thesis) 1966 183 p

(Contract W-7405-ENG-82)

(IS-T-84) Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-2052

Specific heat measurements have been made from 0.2°K to the melting line for solid He^3 at nine densities and for solid He^4 at one density. The results, which cover molar volumes from 23.80 cm^3 to 11.42 cm^3, everywhere are accurate to better than 1% in an equivalent θ_D. The relatively high precision of these experiments and their wide temperature range have enabled us to determine the thermal equations of state of both hcp and bcc solid He^3 quite unambiguously. The $\theta_D(V)$ relationship which we obtain for hcp He^3 gives values of γ which vary from 2.0 at 11.42 cm^3/mole to 2.6 at 19.05 cm^3/mole. For hcp He^4, our value of $\theta_{D4}(V)$ and previous data can be obtained from the simple relationship $\theta_{D4}(V) = \theta_{D3}(V)/1.18$. Dissert. Abstr.

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N68-24454# Congress. House. Committee on Appropriations.
INDEPENDENT OFFICES AND DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT APPROPRIATION BILL, 1969
Evins Washington GPO 3 May 1968 40 p Hearings before Comm. on Appropriations, 90th Congr., 2d Sess., 3 May 1968
(Rept.-1346) CFSTI: HC $3.00/MF $0.65

Estimates for new budget or obligational authority totaling $16,570,580,300 were considered for 20 independent executive agencies, commissions, and offices, and the Department of Housing and Urban Development. Appropriations of $13,670,636,000 were recommended, representing 17.5% less than the amounts proposed. The House committee recommends $4,008,223,000 for NASA, which represents $362,177,000 less than the budget estimate, $580,677,000 less than similar appropriations for fiscal 1968, and almost a billion less than for fiscal 1967. Of the committee proposal for fiscal 1969, $45,000,000 is for construction and modification of NASA facilities; $648,200,000 for administrative operations; and the remainder for research and development activities during fiscal 1969. The committee recommends that only the most important and highest priority programs be funded at the present time. M.W.R.

N68-24494# General Electric Co., Philadelphia, Pa. Missile and Space Div.
A FUNCTIONAL BASIS FOR PLANNING ADVANCED TECHNOLOGIES
M. L. Cutler Jun. 1967 35 p refs
(Rept.-67SD257)

Progress in basic functions, such as transportation, communication, computation, and the like can be measured, graphically displayed and used as a guide for projecting future progress. When the units of measure selected are both technologically significant and indicative of progress, growth proceeds in a series of cycles, bounded on the upper side by a primary growth trend of the form ae^{bt}. This outer envelope represents the latest state-of-the-art, and can be used to uncover technological and timing problem areas for planning advanced technologies. Case histories, methodology, pitfalls and uses for management planning are provided. Sample forecasts of the future capability to perform selected functions are also provided. Author

N68-24538# Congress. Senate. Committee on Aeronautical and Space Sciences.
NASA AUTHORIZATION FOR FISCAL YEAR 1969, PART 1
Washington GPO 1968 375 p Hearings before the Comm. on Aeron. and Space Sci., 90th Congr., 2d Sess. on S. 2918, 27–29 Feb. 1968
GPO: HC $1.00; CFSTI: MF $0.65

Hearings on S. 2918 held on February 27, 28, and 29, 1968, before the Senate Committee on Aeronautical and Space Science are reported. Testimony and prepared statements by NASA administrators are included in support of the bill to authorize fiscal 1969 appropriations to NASA for research and development, construction of facilities, and administrative operations. Administrative operations budget and cost summaries are shown; and costs of manned lunar landing, Mariner Mars missions, and overall space science projects are included. One hundred NASA contractors are listed according to net value of direct awards, and mention is made of university grants and trainees. Details are included for aspects of the Apollo project and the Apollo Applications program, as well as for various aspects of funding. M.W.R.

N68-24539# Congress. Senate. Committee on Aeronautical and Space Sciences.
NASA AUTHORIZATION FOR FISCAL YEAR 1969, PART 2
Washington GPO 1968 444 p Hearings before Comm. on Aeron. and Space Sci., 90th Congr., 2d Sess. on S. 2918, 5, 19, 26 Mar.–23 Apr. 1968
GPO: HC $3.00; CFSTI: MF $0.65

Hearings on S. 2918 held March 5, 19, and 26, and April 23, 1968, before the Senate Committee on Aeronautical and Space Sciences are presented. Testimony and statements by NASA officials are included relating to management, aircraft technology, and space technology; radioisotope generator systems and technology; reactor technology; the deep space, manned space flight, and satellite networks; and NASA communications systems. Other sessions deal with aeronautics and sounding rocket support, the data relay satellite system, automatic data processing, and cooperative efforts with other agencies. Advanced research and technology, space nuclear propulsion, and NASA lifting devices are also discussed during these hearings on the fiscal 1969 budget. M.W.R.

N68-24540# Congress. Senate. Committee on Aeronautical and Space Sciences.
NASA AUTHORIZATION FOR FISCAL YEAR 1969. PART 3: NUCLEAR ROCKETS PROGRAM
Washington GPO 1968 299 p Hearings Before Comm. on Aeron. and Space Sci., 90th Congr., 2d Sess. on S. 2918, 24–25, 30 Apr. 1968
GPO: HC $3.00; CFSTI: MF $0.65

Hearings on S. 2918 held April 24, 25, and 26, 1968, before the Senate Committee On Aeronautical and Space Sciences are presented. This volume details the nuclear rockets program and contains the cumulative indexes for this and the other two volumes on NASA appropriations for fiscal 1969. Testimony and prepared statements deal with the NERVA engine, biosatellite program, 1973 Mars mission, tracking networks, and other aspects and supporting activities related to nuclear rocket technology. M.W.R.

N68-24567*# National Aeronautics and Space Administration, Washington, D. C.
MANAGEMENT: A CONTINUING LITERATURE SURVEY, WITH INDEXES, 1962–1967
May 1968 87 p refs
(NASA-SP-7500(02)) CFSTI: HC $3.00/MF $0.65 CSCL 05A

A bibliography of annotated references to unclassified reports and journals articles on various aspects of management was taken from entries to the NASA information system between 1962 and 1967. Abstracts as well as subject matter, author, and corporate source indexes are presented. References are given under the general categories of program management, contract management, research and development, management tools and techniques, personnel management, urban management, management policy and philosophy, and economics. A category designated general includes conference proceedings, reviews, patent information, speeches, and other bibliographies. M.W.R.

N68-24640*# Syracuse Univ., N. Y.
THE IMPLICATIONS OF PRESIDENT JOHNSON'S MEMORANDA OF SEPTEMBER 13 AND 14, 1965, FOR THE FUNDING OF ACADEMIC RESEARCH BY FEDERAL AGENCIES, PART 1
James D. Carroll 1967 251 p refs
(Contract NASr-206)
(NASA-CR-86739) CFSTI: HC $3.00/MF $0.65 CSCL 05A

This study aims to review and examine selected aspects of the policies and procedures of federal agencies in funding academic research, with emphasis on the period 1960 to 1965, and to analyze the implications of demands for changes as expressed in the President's Memoranda. The ultimate purpose of the study is to contribute to an understanding of basic issues involved in

such funding in the 1960s and 1970s and to provide suggestions for resolving these issues. The study is limited to the demands for change as exemplified in President Johnson's Memoranda, which direct agencies to allocate research funds to more institutions than in the past, and to provide broader forms of support to researchers and institutions. Other major topics of the study are: (1) the federal academic research funding system and its impact on the financial structure of higher education in the United States; (2) the legal and administrative decision making patterns used by federal agencies to fund academic research; and (3) the expression of demands on the academic research funding system, 1960–1965. K.W.

N68-24707# Joint Publications Research Service, Washington, D. C.

PLANNED ECONOMIC DEVELOPMENT OF SCIENTIFIC RESEARCH

T. Malacopol 27 May 1968 16 p Transl. into ENGLISH from the Publ. "Probleme Economice" Bucharest, Mar. 1968 p 14–25

(JPRS-45494) CFSTI: HC $3.00/MF $0.65

The organization, planned management, and coordination of scientific research work are discussed in the context of the tremendous impact that such research has on the national economy. The formation of the material base needed for further all-around development of Rumanian science is emphasized, and the steps being taken to achieve an increasingly pronounced transformation of science into a direct production force are enumerated. The problems involved in financing scientific research are examined, the science–government relationship is explored, and ways of exploiting the researchers' talents and creative abilities are assessed. The point is made that correlation of the technical and specialized aspects of the studies with the economic and financial ones, and collaboration between the economic and scientific communities, are increasingly important factors in socio-economic progress. M.G.J.

N68-24924*# Syracuse Univ., N. Y.

THE IMPLICATIONS OF PRESIDENT JOHNSON'S MEMORANDA OF SEPTEMBER 13 AND 14, 1965, FOR THE FUNDING OF ACADEMIC RESEARCH BY FEDERAL AGENCIES, PART 2

James D. Carroll [1967] 326 p refs

(Contract NASr-206)

(NASA-CR-85721) CFSTI: HC $3.00/MF $0.65 CSCL 05A

The purpose of this study has been to examine the policies and procedures used by federal agencies in funding academic research, and to assess the implication of President Johnson's Memoranda of September 13 and 14, 1965, for the development of these policies and procedures. This study has argued that the academic research funding system has been subjected to four major demands in the 1960's, the demand for responsibility in the administration of funds, the demand for equity in the distribution of funds, the demand for the use of educational criteria in the administration of funds, and the demand for an increase in efforts to apply science to social needs. It is concluded that the President's Memoranda indicate the further recognition of institutions, as institutions, as the proper recipients of funds. It is further concluded that the project system should be retained in the primary method of funding research for the advancement of science and the realization of agency missions, but that a new funding system based on regional considerations should be developed. Author

N68-25125 Arizona State Univ., Tempe.

THE DEVELOPMENT OF A COMPLETE MULTI-PROJECT SCHEDULING SYSTEM USING A FORECASTING AND SEQUENCING TECHNIQUE

Larry Glenn Fendley (Ph.D. Thesis) 1967 289 p

Available from Univ. Microfilms: HC $13.05/MF $3.75 Order No. 67-3199

A total-system approach was taken to the multi-project scheduling problem. Rather than treat the problem as one of determining the best priority rule or the best progress-reporting system or the best expediting system, the problem was treated by designing a scheduling system which accommodates projects from order date to finish date. Incoming projects were considered to be PERT-type projects entering an organization with limited resources with which to perform each project by a set due date. The digital simulation technique was used to test eight priority rules and to provide data for use in finding a method for setting due dates. It was found that the minimum-slack-first priority rule, when coupled with a forecasting technique for setting due dates, performed well in meeting those due dates. Dissert. Abstr.

N68-25221*# National Aeronautics and Space Administration, Washington, D. C.

CUMULATIVE INDEX TO NASA TECH BRIEFS, 1963–1967

Apr. 1968 376 p refs

(NASA-SP-5021(06)) CFSTI: HC $3.00/MF $0.65 CSCL 05B

This cumulative index to NASA Tech Brief lists single page descriptions of individual innovations, devices, methods, or concepts published from 1963 through 1967. A subject index, as well as indices relating Tech Brief number with originating source and number are provided. Subject categories covered are: electrical (electronic); physical sciences (energy sources); materials (chemistry); life sciences; mechanical; and computer programs. G.G.

N68-25412# American Inst. of Physics, New York.

AUDACIOUS–AN EXPERIMENT WITH AN ON-LINE, INTERACTIVE REFERENCE RETRIEVAL SYSTEM USING THE UNIVERSAL DECIMAL CLASSIFICATION AS THE INDEX LANGUAGE IN THE FIELD OF NUCLEAR SCIENCE

Robert R. Freeman and Pauline Atherton 25 Apr. 1968 54 p refs

Grant NSF GN-433)

(AIP/UDC-7)

The report describes an experimental system for remote direct access to files of computer-stored information which has been indexed by the Universal Decimal Classification (UDC). The data base for the experiment consisted of references from a single issue of Nuclear Science Abstracts. The Special Subject Edition of UDC for Nuclear Science and Technology was also stored in the computer so that users could discover how to translate their questions from natural language to logical statement containing UDC numbers. It is concluded that the technical feasibility of use of existing classification and indexing tools, such as UDC, was demonstrated. However, detailed attention to all facets of man-machine communication is a necessity if systems are to be designed which will be voluntarily used. AUDACIOUS is reviewed and criticized from this point of view. Finally, it is concluded that the use of UDC in an on-line, interactive system may have important ramifications for the development of international information networks. Conversion tables (schedules) already exist which would allow speakers of many languages to search files indexed by UDC without regard to national or linguistic boundaries. Author

N68-25425# Congress. House. Committee on Science and Astronautics.

A SURVEY OF VIEWS OF LEADING INDUSTRIAL EXECUTIVES ON THE NATIONAL SPACE PROGRAM

Washington GPO 1968 24 p Hearings before Comm. on Sci. and Astronautics, 90th Congr., 2d Sess., Ser. P

An informal survey was undertaken to poll the executive or corporate opinions of the 750 largest corporations listed in the 1967 Fortune supplement. The eight questions answered by 449 executives, pertained to NASA budget appropriations; manned lunar landings in this decade; national priorities; scientific, technological, and utilitarian contributions of the space program; and the relative efforts of NASA and the Department of Defense on space projects. The replies show: (1) Most respondents (47.8%) considered the $5 billion NASA budget about right, and 54% felt that the goal

of a manned lunar landing should be maintained. (2) The space program was rated third in priority. (3) Contributions to science, technology, meteorology, education, and navigation were listed as areas in which the space program was making contributions. (4) The largest group of respondents (37%) indicated that about the same relative effort should be maintained by NASA and DOD.
M.G.J.

N68-25625 Department of Housing and Urban Development, Washington, D. C.
PROCEDURES FOR DETERMINING NEEDS, METHODS, AND COSTS FOR INSULATING EXISTING HOUSES NEAR AIRPORTS AGAINST AIRCRAFT NOISE
Robert J. Miller, Dwight E. Bishop (Bolt, Beranek and Newman, Inc.), and Leo L. Beranek (Bolt, Beranek and Newman, Inc.) [1967] 35 p refs Presented at the Intern. Conf. on the Reduction of Noise and Disturbance Caused by Civil Aircraft, London, Nov. 1966
(INC/C5/P3)

Outlined are simple procedures for determining methods and costs to improve noise insulation of houses located near airports. A composite noise rating is developed from perceived noise levels, and criteria of acceptability are formed by examination of complaint histories in a number of different airport communities. The exact level of noise reduction varies slightly with the type of noise source and the geometric relationship of the aircraft flight path in respect to the house. Included are tables and figures to provide corrections to noise insulation values as needed for individual shielding or excess air attenuation aspects. G.G.

N68-25638*# New York Univ., N. Y.
PRIVATE TECHNOLOGICAL INPUTS TO THE PUBLIC SYSTEM
Herman G. Berkman [1967] 22 p refs Presented at the 1967 Ann. Meeting of the Am. Soc. for Public Administration, San Francisco, 28 Mar. 1968
(Grant NGR-33-016-067)
(NASA-CR-84729) CFSTI: HC $3.00/MF $0.65 CSCL 05A

The question of whether expenditure for aerospace activity generates inputs useful to the administration of public systems is discussed. Emphasized are areas of innovation and change generated by the aerospace industry. It is postulated that although expenditure for space exploration might be better reallocated for direct research on such pressing problems as waste disposal, crime control, welfare administration, the war against poverty, and slum traffic control; spin-off from these directions though not made specifically for these purposes, indirectly generates technology and innovation useful in solving such public issues. Also discussed are trends in research spending; the role of government and industry in areas of management techniques and technology; public and private management systems; and public systems engineering problems resulting from the gap between technological developments and public utilization. S.C.W.

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